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Georgia
State Board of Entomology

ATLANTA, GEORGIA

BULLETIN 54 **MARCH, 1919**

COMMON
INSECTS AND DISEASES OF THE APPLE

BY
W. W. CHASE
Assistant State Entomologist

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BY

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SCHEDULE

Condensed Spray Schedule for Apples.

The Winter Spray. Spray at any time when the tree is dormant, preferably just before the leaf buds open, with concentrated lime-sulphur solution diluted as recommended on page 16. Controls, or helps to control or prevent, San Jose scale, green aphis, rosy aphis, apple scab, leaf spot and bitter rot. For control of heavy infestations of San Jose scale spray twice, once in the fall and again in late winter, with soluble oil, or lime-sulphur, or both.

The Summer Spray Schedule.

(1) Spray after the bloom petals have fallen and before the calyx cups close with five quarts commercially-made lime-sulphur (or its equivalent of the home-made) and one pound powdered lead arsenate to fifty gallons water. For codling moth, curculio, aphis, scab, leaf spot, etc.

(2) Two to three weeks later with the same formula as for (1). For codling moth, etc.

(3) Three weeks after second application spray with Bordeaux mixture (see page 31), adding one pound powdered lead arsenate to each fifty gallons. For bitter rot, codling moth, etc.

(4) Three weeks after third application spray with same formula as for (3). For codling moth, bitter rot, etc.

(5) One month before fruit ripens for picking, spray with same formula as for (4). For bitter rot, codling moth, etc.

Some varieties do not require five summer treatments. If only three applications are made use Nos. 1, 2 and 3; if four, Nos. 1, 2, 3 and 4.

COMMON
INSECTS AND DISEASES OF THE APPLE

BY

W. W. CHASE
Assistant State Entomologist

Introduction.

In substance and purpose the contents of this bulletin are practically identical with Bulletin 38, published by the State Board of Entomology in May, 1913. The issue of that bulletin having become exhausted it becomes desirable to replace it with another dealing with the same and related subjects for the benefit and guidance of apple orchardists.

Since the publication of Bulletin 38 the Department of Entomology has systematically worked and experimented from year to year with phases of the industry relating to the planting, pruning, cultivating, fertilizing and spraying of apples. In this work much valuable data have been acquired. Improvements on older methods have been obtained in some instances, and modification of spray methods and materials have made for greater efficiency in results. These modifications and improvements are incorporated in this bulletin and to that extent the text of Bulletin 38 has been revised and brought up to date. The scope of this bulletin is too wide and varied readily to permit of detailed treatment. Nor, is this desirable. The principal purpose is to provide the Georgia grower with illustrated descriptions, the study of which will enable him at first hand to identify his orchard pests by name, and to prescribe an effective remedy.

For the past ten years or more the apple industry in Georgia has been developing rapidly and, for the most part, on a sound, substantial basis. The opportunity and the right conditions are here. While comparatively a new development, a sufficient number of commercial orchards are producing apples for the market to give reliable information bearing on the profits to be reaped from the industry. The records of these orchards in commercial production leave us no room for doubt. In every instance where the prerequisites have been met success has followed. As in all other lines of human endeavor, the measure of success in each case has been determined by the foresight, judgment, and studious diligence with which the grower has planned and developed his orchard interests. There have been failures for very evident reasons. The natural conditions for apple production in favored sections of the State, while answering all essential requirements, are not sufficient of themselves to insure success. They must constantly be aided by the intelligent effort of the grower. To this end the prospective investor should be advised to equip himself in advance to avoid at each step the errors that snare the uniformed, the misinformed, the careless and the over-optimistic.

Not the least of the essentials of successful apple growing is a working knowledge of the several insects and diseases to which apples and apple trees are subject and of dependable means to prevent or control them. An attempt has been made in the following pages to give to growers descriptions by which the most important and destructive pests may be identified, with recommendations for control.

In addition to the spray schedules, there are incorporated in the bulletin a few brief notes on the care and management of apple orchards. To beginners this information will be of interest and benefit by enabling them to avoid some of the initial mistakes which, after the orchard is set and growing, are difficult or impossible to rectify.

The apple industry of Georgia is destined to bring added horticultural fame to the State and to become a new and rich source of revenue. For these and other reasons its legitimate development deserves to be fostered, and built upon a sound and enduring foundation.

THE CODLING MOTH.

(*Cydia pomonella,* L.)

Of the insects preying directly upon the fruit of the apple the codling moth, or "apple worm," is the most important economically. Because of its universal distribution it is well known both to apple producers and consumers. To the latter only the form of the insect's injury to the fruit is familiar, the worm itself usually having forsaken the apple when it is bought for consumption. Every one has at one time or another opened an apple to find it tunnelled by cavities with blackened walls, and partially filled with the blackish frass, or castings of the worm. The agent of these hidden and distasteful mining operations is thse larva of the codling moth.

But it is to the grower that the insect is best known and most unwelcome. To him the work of the moth represents steadily cumulative losses throughout the whole season. A large percentage of the apples which fall prematurely from May until harvest time are victims to the greediness of its larvae. One has but to keep a record of the windfalls from a single unsprayed tree for a season, classifying them in accordance with the initial cause of their downfall, to realize that the apple worm is an uninvited guest with an appetite which is costly to feed. Not only does it cut off immature apples from all possibility of maturity, but so conditions others that cling to the tree that they are, at best, unfit for sale, except as culls.

Fortunately, though the codling moth is most destructive when left to its own devices, it is amenable to control through the medium of spraying with arsenical and other poisons. Its ravages can be largely checked even by a single spraying with the right material applied at the proper time. The grower has no reason or excuse, except lethargy and disinterest, not to save his crop for himself rather than to abandon it as food to fatten worms.

Life History.

In order successfully to combat an insect it is necessary that we know something of its life history. Most insects are more vulnerable to attack at one stage of their development than at others. Having determined that stage and its duration it is then our part in the warfare to administer measures which will stop or restrict the destructive activties and the fecundity of the insect to a minimum.

The life history of the codling moth from egg to adult is in four stages, viz., the egg, the larva, or "worm," the pupa and the moth. Normally, there are three broods annually in Georgia.

The Adult. The adult insect is a moth having a wingspread of from one-half to three-quarters of an inch. The forewings are striped transversely with alternate dark gray and brown. The hind wings have the same general coloring of the body, i. e., a grayish-brown. The moth is semi-nocturnal in its habits, confining its activities to dusk and early dawn. For this reason, and because of the manner in which its color blends with its natural surroundings, it is nearly invisible and is seldom seen.

The egg laying season begins in the early spring several days after the moth emerges from hibernation. It is renewed at intervals, coincident with the arrival of adult female moths of successive broods, until well into September. Approximately eighty-five per cent of the eggs are laid on the leaves. Considerable variation is shown among individuals in the length of life of the moth and in the number of eggs deposited. The average of the latter is about fifty.

The Egg. The eggs of the first brood begin to be deposited by the adults of the over-wintering cocoons the last of April or early in May in the latitude of Cornelia. The deposition of eggs continues through succeeding generations, the average number of eggs per female increasing with each generation until it reaches its maximum with the third brood. There is a partial overlapping of generations, which renders egg laying more or less continuous throughout the summer.

The eggs are laid singly and separately, mostly upon the upper surfaces of the leaves. When first deposited they are of a milky white color, circular in outline, of about the diameter of a pin, the upper surface slightly convex. When they have attained a certain stage of incubation, which is variable according to season and temperature, a reddish ring appears round the center of the egg, this ring later changing to a black spot. The egg is then almost ready to hatch. Early in the season eggs require eight to ten days to hatch but, as the season advances, they require fewer and fewer days, striking an average of about five days in June, July and August.

The Larva. From the egg emerges the newly hatched larva. The length of the tiny worm is then only about one-sixteenth of an inch. It proceeds almost at once to crawl to the nearest apple, selecting sometimes, as a point of entrance, an abrasion of or break in the skin of the apple, but usually the blossom, or calyx, end. It is not an uncommon thing to observe the larva first feeding on the leaf, especially when it chanced to hatch at some distance from an apple. Most of the invasions of the fruit are effected through the calyx, as this opening affords better protection and less natural resistance to the larva. The writer has more than once observed larvae enter through the feeding and egg laying punctures of the curculio, a beetle discussed in another chapter of this bulletin. They will, however, oftentimes perforate the unbroken skin of the fruit. The larva's entrance is usually protected by a network of silken threads which it spins at the point of entrance.

When very young the larva is white, but this color changes to a pale pink with age and the growth of the grub. There are three pairs of true legs on the anterior part of the body and five pairs of pro-legs on the abdominal segments.

As the larva feeds it increases rapidly in size. The castings produced along the journey into the fruit are at first thrust out of the opening made by the larva in entering. This mass is held together by silken threads. It is an easy matter to detect an infested apple by the mound of brownish castings pushed out of the entrance cavity to the surface. Later, as the larva eats its way into the apple, usually towards the core, the voidings are thrust back into the channels made by the worm in feeding. Full growth is attained in approximately three weeks (again a variable item), and the larva is ready to leave the fruit to pupate. When fully grown it measures an average length of about three-quarters of an inch.

Being ready to make its exit from the apple, the worm either makes use of the entrance channel for that purpose or eats its way out at another point.

Effects on Fruit of Larval Feeding. Infested apples, up to the time when they are half-grown or larger, generally fall from the tree. This does not occur as a rule, however, until after the emergence of the larva. In the latter part of the season just preceding harvest most of the infested fruit holds to the tree but is, of course, greatly depreciated in value if not worthless.

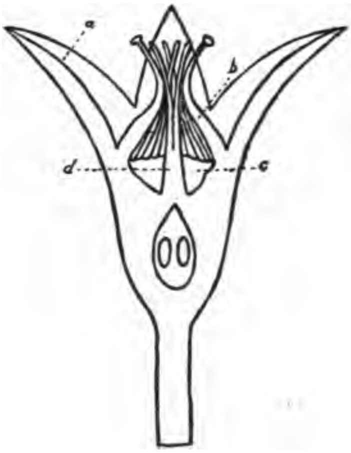
The Pupa. After leaving the apple the larva seeks a favorable place in which to spin its cocoon, preparatory to pupation. Sometimes it lowers itself directly to the ground by means of the silken thread it has the faculty of spinning in such prodigal plenty at all times, pupating in litter or such other protection as it finds upon the ground. Usually, however, it crawls down the limbs of the tree to the trunk and hides there under loosened bits of bark or in crevices and cracks in the wood. Here the larger number of the larvae pupate, after spinning about themselves an elongated, tightly woven cocoon. In this silken sleeping shroud are undergone the slow invisible transformations from larva into pupa and from pupa to the winged moth.

The pupa is a contracted embodiment of the larva. The average length is about one-half an inch. The color ranges from light to dark brown. The duration of the pupal stage is a factor in the life cycle exhibiting wide variation. The average time is from two weeks to sixteen or eighteen days. Eventually the pupa issues forth a full-fledged moth and, as an adult, is ready to start the cycle over again. Following a brief interval the females begin to lay eggs for the next succeeding generation. The larvae entering cocoons in the late fall do not at once pupate but hibernate as larvae, pupating on the arrival of warm weather the following spring.

Treatment.

From the foregoing it will be seen that the control of codling moth must mainly be founded on measures prohibitive of the entrance of the larva into the fruit. The most effective medium by which this end may be secured is the use of poison sprays. There are several arsenicals which have been and are being used, but for purposes of efficiency and freedom from foliage and fruit injury, etc., arsenate of lead is most generally and satisfactorily used at the present time. No consideration need be given here to auxiliary means of suppressing colding moth fecundity. The old method of banding trees to trap larvae, and later destroying them by hand proved to be too laborious and ineffective, and is now obsolete. Clean, smooth trees and ground free of litter and rubbish are unquestionably aids to the orchardist by depriving the larvae of favorable conditions for pupating, but such conditions are not essential, only desirable. Though a most pernicious enemy of the apple industry where no fight is made against it, satisfactory control can be secured by timely and thorough spraying without the aid of supplementary measures.

When to Spray. The physical changes peculiar to the apple from the blooming period until the sepals close, and the fact that most of the larvae enter through the calyx end, render the so-called calyx cup application the principal defense against infestation. The first codling moth spray is all-important, and upon its timeliness and thoroughness of application depend the grower's chances of success. After the calyx cups have been filled with poison and the calyx lobes have closed upon it, the fortification of the apple against infestation from that direction is complete. The first food taken by the young larva as it sought to eat its way through would result in death. Theoretically, one hundred per cent freedom from apple worms by way of the calyx cavity may be obtained by filling both outer and inner cups with an arsenical poison.



Following the shedding of the bloom the young apple is at the right stage of development for the first codling moth spraying. See Plate, III fig. 2. At that time a cross section of one resembles the accompanying figure. The outer cup (a) is so shaped as to catch and retain the poison, but the entrance to the inner cup (c) is obstructed by the pistils (d) and their encircling stamen-bars (b). It is evident that it is not sufficient merely to fill the outer cup. The spray must be applied with enough pressure and volume to force it by the obstructing stamen-bars. Maximum good results will not be secured unless and until that is accomplished.

How to Spray. All the experimental work of the writer, as well as that of others elsewhere, demonstrates that the best results are obtained by making the calyx cup application with a nozzle throwing a heavy, coarse spray under high pressure—from 200 to 300 pounds. This combination of nozzle and pressure gives better results than if the application is made with a fine, mist-like spray under weaker pressure, for the reason that the inner calyx cups are more thoroughly impregnated with poison. The fruit clusters at the stage of development indicated by fig. 2, Plate III, point in all possible directions and they must have the spray driven directly and forcibly into them. This means that the nozzle must be carried to all parts of the tree, inside and out, and at all angles. Spraying very tall trees from the ground will not reach the bloom end of the fruit clusters pointing upward in the top. These topmost clusters should be reached from a tower mounted on the spray wagon.

The imperative necessity of thoroughly filling the calyx cups at this spraying demands thorough, conscientious work on the part of the nozzleman. Too much stress can not be laid upon making the application liberal and painstaking. The spray material used in this spraying if rightly applied will be from one-third to one-half again as much as that used in any subsequent summer spraying. But all expenditures of time and care and material will yield a good dividend in the cleanliness and extra value of the fruit.

Formulas and Spray Schedule.

Fortunately, lead arsenate and the other arsenical poisons by which control of codling moth is effected, can be added to a fungicidal spray without losing their active poisonous properties. By thus combining lead arsenate and a fungicide, such as a weak solution of lime-sulphur or Bordeaux mixture, not only may codling moth be controlled but the damage caused by certain fungus diseases, such as apple scab, leaf spot, and bitter rot, may be prevented. For these good reasons all the spring and summer spraying of apple trees should be with a combined insecticide (as, for example, lead arsenate) and fungicide (dilute lime-sulphur or Bordeaux mixture).

First Application. Spray immediately after the petals have dropped with one pound powdered lead arsenate and one gallon and a quart of concentrated lime-sulphur solution to fifty gallons water. If the lime-sulphur is of 32° or 33° density, Baume, five quarts are recommended. If the density of the lime-sulphur solution is less the amount should be increased in the proportions set forth in the table on page 16. Place the lime-sulphur in the barrel and fill almost full with water. Mix the arsenate of lead thoroughly with water and add to barrel last. Use the mixture at once. Do not allow to stand for any length of time.

Second Application. Three weeks after first application spray again with same formula used in first treatment. This is a calendar rule and has its limitations. To determine the exact timing of the second application, thereby securing the maximum benefit from the treatment, the following procedure is strongly recommended. In late winter select several trees that are harboring winter cocoons and enclose their trunks in wire netting from about an inch below the ground to eighteen inches or two feet above. Fit the top of the screen tightly to the trunk and the bottom in the soil several inches out from the base, joining the overlapping edges so as to make a good trap. Watch these traps daily. Spray from twelve to fourteen days after the day the first moth emerges and is captured in the trap.

Third and Subsequent Summer Sprayings. If sprayings later than the two above are to be made for the control of codling moth and of bitter rot (which see), add one pound of powdered lead arsenate to each fifty gallons of whatever fungicide is used.

In order to give maximum protection to apples from codling moth it is recommended that the spray schedule outlined on page 31 for the control of bitter rot be followed, adding one pound of powdered lead arsenate to each fifty gallons of dilute spray solution used.

Type of Spray Nozzle To Use. For the first codling moth spray it is desirable to use what is known as the Bordeaux or Clipper type of nozzle. These types are kept in stock by all hardware men and others who handle spray machinery and accessories. They throw a flat, solid stream with considerable force and by it a better penetration and filling of the calyx cups can be obtained. Subsequent sprayings may be made with any of the standard types of disc nozzles which discharge a cone-shaped spray mist.

SAN JOSE SCALE.

(*Aspidiotus perniciosus,* Comstock.)

The codling moth has been considered, by reason of its feeding and reproductive habits, essentially as a feeder upon and destroyer of the apple· In the case of San Jose scale we encounter an insect which attacks the tree as well as the fruit. The deadly destruction worked by this little parasite does not stop with the toll it takes in unmarketable fruit, but threatens, wherever present, the life of the tree itself. Except for a few fortunate localities it is present in orchards all over the State, and is everywhere an active menace to the welfare of deciduous fruits. While we may ignore other injurious insects and possibly not suffer the total loss of our trees and fruit, we can not pursue a "let-it-alone" policy with San Jose scale and save a decent or considerable portion of the one or the other.

San Jose scale belongs to the great class of sucking insects, and takes its food in a liquid form from the host plant by means of a long bristle-like proboscis which it inserts into leaf, or limb, or fruit, as the case may be. This fact renders the insect immune to arsenical poisons which must be taken internally to be effective. As an individual scale is powerless of itself to remove from one tree or plant to other trees or plants not in actual contact, it follows that the destruction of scale insects upon a tree removes at once the injury to that tree and the liability of its fruit to injury or ruin. This is accomplished through the agency of what are known as contact sprays, that is, sprays which applied externally to the scale-covered bodies of the insects, penetrate and kill them. Such sprays are most successfully applied in the winter season for the reason that the tree is then dormant and powerful contact poisons may be used which, because of their strength and causticity, cannot be applied with safety when the tree is in foliage.

Life History.

As the name Scale suggests, the insect is protected by a hardened, waxy excretion under cover of which it feeds and breeds. Save for a few hours after birth, during which they crawl about, the female scale insects pass their entire existence under this covering and die there. The male insects, on the other hand, emerge from the scale casings, after they have passed through several molts, as delicate two-winged flies. As flies their life is very brief, just long enough, in fact, to allow them to unite with the scale-imprisoned females. Since the latter do not at any time during their life cycle possess wings it is readily seen that the spread of San Jose scale must depend on forces outside of itself for transportation from one plant to another.

The winter is passed in the half-grown stage under small, round, black scales. Individual living scales at this time are no larger than the diameter of an ordinary pin and in small numbers are so insignificant in size as to be invisible to all save the eye trained to observe them. Very early in the spring the males pupate, emerging soon thereafter to unite with the females, which by then have arrived at the proper development for complementary reproductive functions. In about three weeks or a month afterwards the young of the first brood appear. These are borne alive by the mother insect without an intermediate egg stage. The female continues for several weeks to give birth to the young before she dies.

The newly born insects are light yellow in color. They crawl about for a number of hours before finally settling down in fixed and permanent positions. The long sucking tube or proboscis through which they imbibe their food is inserted into the tissues of the plant, and the formation of the scale cover begins at once. This covering is at first white, but changes in color through the successive molts of the insect to gray or black.

Each scale is surmounted at the apex by a nipple. The female scale is perfectly round and this nipple is at the top center. The male scale is elongated in shape and the nipple is present at the anterior, or head end· The conformation of this nipple is characteristic of San Jose scale and differentiates it from other species which otherwise outwardly resemble it. The size of individuals of both sexes materially increases with age, and the male, from being round in outline at first, assumes the elongated shape which distinguishes it from the fully developed female. Each generation requires from thirty-three to forty days from the emergence of the larvae of one brood to the emergence of the larvae of its offspring. The average period of parturition by the females being about six weeks, there consequently is a well defined overlapping of broods during the summer months.

Since the female never leaves its scale cover it is evident that the spread of the insects from one plant to another and from one premises to another is always effected artificially. New scale infestations are usually set up locally by the removal of the crawling young from their birthplaces to other places on the legs and bodies of larger insects, by birds, on the clothing and persons of orchard workers, by plough animals and possibly, for short distances, by high winds. Scale-infested nursery stock is the commonest cause of long distance infestations, and for this reason it may readily be seen how important it is to protect one's self against the scale by setting a guard against the introduction of infested nursery stock into uninfested territory.

In Georgia, San Jose scale breeds from March until November and, in exceptionally mild falls, probably until December. The writer has seen the crawling young in a peach orchard at Fort Valley as late as November 26. Allowing forty days to a generation, this means that five full generations are easily possible in the 214 days from April 1 to October 31. In all probability there are more than five. Estimating 200 females as the offspring of a single mother of the first generation, Marlatt shows a possible progeny of 3,216,080,400 at the fifth brood.* These figures offer explanation of the near destruction which is only too commonly seen of entire orchards in a single season where conditions have been particularly favorable for multiplication of the insects.

Characteristic Injury Caused by Scale. The effect of the feeding of many scale insects is the slow sapping and poisoning of the life of the tree or, in the case of infested fruit, its scurfy appearance, spotted discoloration and depreciation or worthlessness as a market product. On smooth bark but slightly infested there is a red or purplish discoloration of the bark surrounding the insects. This discoloration in more severe instances extends clear through the bark and down to and into the wood. The second result of the sucking of the juices of the bark and the toxins introduced by the scale into the sap flow is a pitted or indented twig or limb. In heavy infestations the scales overlap each other, literally encrusting the bark, so that it can not be seen at all, and the tree then has the appearance of having been dusted over with ashes. By the time infestation has progressed that far the tree is either entirely dead or nearly so. On a badly infested tree during the breeding season one can see with the naked eye thousands of the tiny yellow young crawling about.

The apples themselves offer tempting conditions to the crawling larvae and consequently they are freely infested if any scale are present on the tree. Even a few scales will discolor the skin of an apple and a medium infestation will stunt its growth, oftentimes leaving the apple cracked and misshapen.

In an eight-year-old apple orchard which the writer once had under observation, San Jose scale was present in small quantities at the beginning of spring. By the first of June these had multiplied enormously and infested both the trees and the fruit. The crop was large at that time but by August more than one-half of it was utterly ruined and the remainder was much discolored and inferior. The damage to the fruit was less than half the story. By winter many of the trees were killed outright, while the rest had dead or dying tops, necessitating the removal of practically the whole top structure. A picture of a section of this orchard is shown on Plate I. As has been stated, the infestation in this orchard early in spring was slight. It did not at that time seem possible that scale could multiply so rapidly in a single season, or with such dire results. It is but an instance of their practically unlimited powers of reproducing themselves and their capacity for working tremendous havoc where conditions are altogether favorable.

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*Bulletin 62, U. S. Bureau of Entomology, Page 49, 1916.

Treatment.

San Jose scale is most successfully combatted in the late fall or winter months for the reasons stated. The infested tree is then dormant and so is immune to spray injury. Spraying may safely be done at any time after the leaves are off until just before the buds begin to open in the spring. Weather conditions most suitable to spraying are usually to be found in the fall months, and there is then an absence of the high winds which prevail in February and March. For several reasons, principally relating to some of the fungus diseases of the apple, it would seem more desirable to apply a full strength combined fungicide and scale insecticide, such as lime-sulphur, within a few days of the time when the leaf buds begin to open. The fungicidal value of such a treatment will thereby exert its maximum strength at a critical period, and extend its good effects into the period of early development of fruit and foliage, acting as an antidote for the diseases which begin their activities at that season. If delayed too long, however, the young leaves may begin to appear before the spraying is completed. The orchardist, therefore, should be governed by the size of his orchard and other conditions. If he cannot postpone his winter spraying until the immediate ante-budding stage and be sure of completing his work before the buds begin to open, he should not take the risk, and his spraying should be done earlier in the winter or in the fall. The essential thing is to make at least one thorough spraying between the time the leaves of one season have fallen and those of the next appear.

Lime and Sulphur vs. Soluble Oil.

For the control of San Jose scale the standard concentrated solution of lime and sulphur is the most widely known and has proved itself uniformly efficient and dependable. Various substitutes for lime-sulphur solution, in the form of so-called soluble sulphur powders, have appeared upon the market in the past few years, but as yet it has not been fully demonstrated that they yield as reliable results, nor that they are materially, if at all, cheaper than the solution. Strictly from the standpoint of controlling infestations of scale, there is only one commercially manufactured rival to lime-sulphur solution whose equal or superior merit has been well established. This is a soluble oil preparation sold under the trade name of Scalecide.

Lime-sulphur solution has advantages in some respects over any soluble oil solution, be it commercially- or home-made, in that it possesses composite properties which are lacking, or at least of doubtful value in the oils. Lime-sulphur is both a scale insecticide and a powerful fungicide. It is a good sanitary agent, causing dead bark and scales to slough off the tree and leaving the bark smoother and cleaner.

There are a nnmber of proprietary, or ready made, solutions of lime and sulphur solution manufactured and sold by competitive chemical companies. All are fundamentally the same and are not widely variant in chemical composition or strength. They are clear amber colored decoctions, free of residue, or sludge. Each gives an average Baume test of about 32 or 33 degrees. The only thing necessary to make them ready for spraying is dilution, according to density, with cold water.

Lime-sulphur concentrate can readily be made at home if the necessary equipment for cooking it is at hand. The tendency of the grower of today is to use prepared commercial preparations rather than to take the time and trouble required for making his own spray chemicals. If the equipment and labor for the work are available, however, a considerable saving of money is realized by buying the raw ingredients and compounding and cooking them at home. This will be found an economical policy for the large commercial grower who uses large quantities of material. For the small grower who has only a few trees it is simpler, easier and not much, if any, more expensive to buy and apply the prepared solution.

For the guidance of any who may wish to cook lime-sulphur solution at home the following formula and method of preparation are given.

How to Make Lime-Sulphur Solution.

The necessary ingredients for making lime-sulphur and the equipment for making it are sulphur, lime containing not more than five per cent magnesium oxide, and an adequate vessel for cooking. Commercial ground sulphur is recommended, rather than the more refined grades, on account of cost. The lime should be the best grade of lump lime, unslaked, or hydrated. If hydrated lime is used one-third more weight should be added than when stone lime is used. The following formula is for fifty gallons. Smaller quantities may be made in the same proportions.

How to Mix and Cook. Heat about ten gallons water in the vessel and to it add 50 pounds of lime (or 67 lbs. hydrated) and when the lime begins to slake add the sulphur, 100 lbs., by degrees, stirring steadily all the while to break up the sulphur. After the sulphur is added and the lime slaked dilute the mixture to fifty gallons and boil for one hour. Water should be added in small quantities at frequent intervals to replace that which evaporates. Always keep the full fifty gallons in the vessel while cooking is in progress. To make that volume of concentrate at one cooking will require a vessel of about seventy-five gallons capacity.

If the solution is not to be used at once strain it into a tight barrel and cork. It will keep indefinitely if kept tightly corked.

Dilution of Home-made Lime-sulphur. Having made the solution do not guess at how much water per gallon should be added to it for spraying purposes. No two cookings will be the same in density, and to arrive at a uniform strength for field use the density of each separate cooking should be determined by means of a hydrometer, a cheap instrument for sale by druggists and supply houses. Having determined the density or strength of your solution by a hydrometer reading, dilute the concentrate according to the following table:

Table Showing Dilution of Lime-Sulphur of Different Densities.

Hydrometer reading (Degrees on Baume Spindle)	No. Gallons Water to each Gallon Solution	Hydrometer reading (Degrees on Baume Scale	No. Gallons Water to each Gallon Solution
35	9	27	6
34	8¾	26	5¾
33	8½	25	5¼
32	8	24	5
31	7½	23	4½
30	7¼	22	4¼
29	6¾	21	3¾
28	6½	20	3½

Recommendations.

As a winter season spray against infestations of scale, lime and sulphur solution is recommended, the application to be made at any time during the period when the tree is dormant. If there is a heavy infestation two sprayings may be necessary, one in the fall and the second in late winter. In such cases it has been found good practice to make the first application with a dependable soluble oil, of which Scalecide is a worthy example, and the second with lime-sulphur solution.

It should constantly be borne in mind that, effectively to rid a tree of scale, requires the most thorough work. Pains must be taken to cover all parts of the tree. One infested limb or twig or even a part of it, left unsprayed by a careless or indifferent nozzleman, may easily be the means of reinfesting the tree the ensuing season.

The application of lime-sulphur or other compounds as a winter spray should be made with a nozzle throwing a cone-shaped mist, medium fine. High pressure should be constantly maintained to make it more certain that the spray solution will penetrate the shell-like scaly cover of the insects.

APPLE TREE APHIDS.

Three species of aphis, or plant lice, are commonly found among the apple orchards of Georgia. One of these, the wooly aphis, works its principal damage on the roots of the tree, and the other two, the green and rosy aphis, respectively, live upon the foliage where they stunt or stop the growth of wood and fruit. Each of these three species is described and discussed in the following paragraphs and recommendations for control are laid down.

The Apple Woolly Aphis.

(*Schizoneura lanigera, Hauss.*)

This species works a two-fold injury to an apple tree, one phase to the limbs and trunk and the other to the roots. The latter type alone is of economic importance, the one which requires specially directed treatment. The aerial form is readily killed by the dilute lime-sulphur spray used to control some of the diseases of the fruit and foliage. Applied with sufficiently high pressure to penetrate the wooly protection under which the insects are partially or wholly hidden, the solution will reach their bodies and destroy them. The white cotton-like substance secreted by the insects protects them against contact sprays unless administered forcefully.

The root infesting aphids, by reason if their feeding habits, damage the roots seriously, causing the knotty growth shown in fig. 2, Plate V, impairing the food-assimilating functions, bringing about their slow death and decay and not infrequently killing the tree. The work of the root-infesting form is all the more serious because hidden, and it too often goes on undetected until too late to save the affected tree.

Description and Life History.

The woolly aphis is a reddish-brown, soft bodied louse occurring upon the tree both above and below the ground and called, respectively, the aerial form and the root form. Both forms, for the sake of protection against their enemies, secrete a soft, fluffy secretion resembling cotton from minute pores in their bodies, and this cotton-like secretion effectually hides the insects from observation, especially those of the aerial form. The lice work together collectively in clusters or colonies within a small space, not singly. Colonies of the aerial form are very conspicuous owing to the white mantle which covers them. The root-infesting lice do not secrete so much of this substance as do the limb-infesting type.

Root-inhabiting wooly aphis live by sucking the sap from the roots, and to them is due the damage done by this species. The aerial aphis establish themselves in crevices or wounds in the bark of limbs or trunk where their feeding is of negligible importance. The discovery of colonies above ground is indicative almost invariably of the presence also of the destructive root-feeding aphis, and shows us the need of applying a corrective. The sucking of the juices from the roots and the introduction by the insects in feeding of a poisonous substance into the sap current results in the formation of knots and galls as shown in fig. 2, Plate V. Eventually gall-bearing roots die and decay, and the aphis remove to uninfested roots and renew feeding there. When a large enough proportion of the root system is involved the vigor and growth of the tree are seriously impaired. The first symptom of the injury as visible on the tree is the pale sickly appearance of the foliage and the generally debilitated condition of the tree. Badly infested trees eventually die.

During the summer months the female aphid brings forth living young by the process of non-sexual parturition. These young, like their mothers, are agamic (non-sexual), wingless females, and in turn they bear young of the same kind and after the same manner as their parents. Finally, at the approach of winter, a few winged asexual females appear in the next to the last generation of the season and these fly to other trees and establish new colonies. From the flying females of this generation a generation of true males and females is produced non-sexually. This last generation of males and females mate, and the latter in a few days deposit one egg each in protected places on and about the tree, which egg hatches the following spring into an asexual female, starting the cycle over again. Wingless agamic females are to be found upon the roots and top structure of trees at all times of the year in this State, so that the perpetuation of the species is apparently independent of the over-wintering egg stage.

Treatment.

Experiments conducted by the State Board of Entomology for the eradication of woolly aphis infestations show conclusively that kerosene emulsion is the most dependable remedy of the series of tests, which included a wide range of materials. In fact, the emulsion was the only solution of the lot which gave a satisfactory percentage of control, and for this reason it appears to be at the present time the only treatment really worthy of endorsement. In recommending it, however, it should be stated that an improperly made kerosene emulsion is a menace to the life of the tree to which it is applied. Unless thoroughly emulsified the kerosene will separate in a free state from the emulsion, and whenever pure kerosene comes into intimate contact with the roots in the soil the roots are sure to be killed, and the tree itself dies. Care should be taken, therefore, thoroughly to emulsify the mixture before applying. This cannot be accomplished merely by stirring the ingredients together. They should be placed in a vessel somewhat larger than is necessary to hold them, to allow for the increase in volume which accompanies the process of emulsifying, and the contents pumped back forcefully and continuously into the vessel for at least ten minutes.

A ten per cent solution of kerosene emulsion, if properly made and applied, will yield well nigh one hundred per cent eradication of root-infesting aphis. A greater strength, therefore, is not necessary.

If the emulsion is carefully and thoroughly made and applied *only in the growing season,* preferably in the spring, no damage to the tree or its roots need be feared. Many materials have been tested for control of wooly aphis but none has proven so effective as kerosene emulsion. In addition to the direct and immediate destruction of the lice present on the roots when applied, the emulsion has another virtue in the protracted after-effects as a repellant against a new infestation of aphis from outside sources. The odor of kerosene lingers in the soil for months after the emulsion is applied and will effectually discourage re-infestation.

Directions for Making Kerosene Emulsion.

Dissolve one-half pound whale oil soap, laundry soap or home-made lye soap in one gallon hot water and bring the soapy water to a boil. Place the water in a galvanized wash tub or other vessel of suitable size, and to it add two gallons kerosene. With a foot, or bucket, pump equipped with a Bordeaux or other nozzle throwing a solid stream, begin at once and pump the mixture back into itself steadily for ten minutes or longer, if necessary. A good pressure should be maintained during this operation to insure a perfect emulsion. Rightly made, the stock solution of kerosene emulsion will stand for a considerable length of time without deterioration. If improperly made, the oil will separate and rise to the top within a few hours or even minutes.

To make a ten per cent emulsion add 17 gallons water to the stock solution.

Larger or smaller stock solutions may be made by adding to or reducing the ingredients proportionately. Larger amounts are readily mixed in barrel pumps.

How to Apply Kerosene Emulsion.

Remove a circle of the top soil to a depth of several inches about the base of the tree, or deep enough to expose or get close to the infested roots. The diameter of the circle will, of course, depend upon the size of the tree to be treated and will vary from about two feet for a small tree to six feet or more for a large one. Apply enough emulsion to wet the soil to a depth of at least an inch or two and replace the top soil. As the efficacy of the emulsion depends upon its being brought into contact with the aphis, enough top soil should be removed and sufficient material applied to establish the contact. Treat trees only in the spring or early summer while they are growing.

The Green Apple-Leaf Aphis.

(*Aphis pomi, DeGeer.*)

This aphid is injurious both to nursery stock and to trees of all sizes and ages in the orchard. The sucking of the leaf sap, usually of the leaves of terminal growth, causes them to curl and wither. When all the leaves of a twig or branch are attacked and cease to function as they should, the wood growth of that twig or branch is either stunted or stopped. On small trees which have nourished a heavy infestation for a season, the resulting dwarfing of the wood growth may not be overcome for years afterwards.

The fruit of bearing trees, wherever the immediately surrounding foliage is badly infested, ceases to grow. The apples of such aphis-infested fruit clusters thereafter remain a fixed size, even though attacked early in the season. Instead of developing normal size and shape they become gnarled and knotty, and, though they do not actually fall from the tree and though they may ripen in season, they are, of course, unfit for sale. The combined damage to trees and fruit is difficult to compute. As a matter of fact, it is far greater than is commonly supposed. Besides the loss of the fruit immediately affected, there is also to be considered the stunting of the wood growth and the atrophy of the fruit buds which otherwise would go to make the crop of the ensuing year. Taken together, these effects are serious and costly.

Description and Life History.

The green aphis, as its name denotes, is a louse of uniform green color. It passes the winter only in the egg stage, differing in this particular from the wooly aphis, which is carried over from season to season mostly as asexual females. These eggs are oval in shape, about one-fortieth of an inch in length, black, shiny, and readily seen by the unaided eye. See fig. 1, Plate V. In the spring usually before the leaf buds open in this State, the eggs hatch into small green lice which force their way down into the opening buds just as soon as this cover is available to them, and feed upon the newly expanded leaf. The lice that hatch from the over-wintering eggs are called stem-mothers and are wingless. These stem-mothers are non-sexual and bring forth their young alive. After hatching from the egg, they molt several times before attaining full growth.

The young borne by the first brood stem-mothers are for the most part winged when fully grown and the females fly to other trees and set up, by the same process of agamic reproduction, new colonies of lice. In this way the infestation is spread from tree to tree and, sometimes, from orchard to orchard. Less than one-half of the progeny of the second generation come into possession of wings, and the fourth generation and all generations after the fourth are wingless, so far as is known, and reproduce by non-sexual processes. The last brood of the summer is composed of true males and females which mate sexually, the females later depositing the eggs as described above.

The green aphis is a sucking insect and lives on the under side of the leaf by pumping out the juices through a slender, minute beak inserted into the sap cells. The sapping of the juices from the under surface of the leaf causes it gradually to curl up into a tight roll.

The green aphis secretes copiously a substance called honey dew through their cornicles or honey tubes, two tubes which are raised conspicuously from the back of the insect, one on either side, near the posterior end. This honey dew is a sweetish, sticky fluid which is very attractive food for ants. The fondness of ants for it accounts for their almost invariable attendance upon the colonies of aphis and the pains the ants take to foster and protect the aphis. A low form of mold, called sooty fungus, grows in the honey dew, and to this fungus is due the sooty-black apearance of any part or parts of a tree badly infested with aphis. Affected leaves are not only curled and withered but blackened also, the first effect being due to the sucking of the lice and the second to the sooty fungus.

Winter Treatment.

As the green aphis passes the winter only in the egg stage, hatching in late winter, and, as it is possible more effectually to destroy the eggs and the larvae newly hatched from the eggs than it is to disinfest a leafed tree in summer, the late winter treatment is the most dependable means of control. The prepared concentrated lime-sulphur solution used against San Jose scale, if applied to the aphis eggs, will prevent practically all of them from hatching. The effectiveness of lime-sulphur against the eggs and larvae is greatly increased by the addition of Black Leaf 40 at the rate of one part Black Leaf 40 to 750 parts diluted lime-sulphur spraying solution. To derive maximum results from this treatment the application should be made to the trees just a few days prior to the budding of the leaves. In small orchards that permit of quick spraying it is entirely feasible to time the winter spraying for that period. In large orchards that require a week or more to spray it is not always safe to defer the winter spraying so late in the season, as a protracted rainy spell at that time might easily prevent spraying operations long enough to allow the leaf buds to break and open, thus making it impossible to apply the lime-sulphur at the regular concentrated winter spray strength.

It must not be lost sight of that the eggs of green aphis are laid for the most part on the terminal twigs and smaller branches, and to kill them and the larvae that hatch from them, every twig on the tree, clear to the topmost growth, must be thoroughly covered with spray. Most of the eggs that are not sprayed will hatch and, even though the remainder are killed, the relatively few that hatch will bring forth many and these many more until, before the end of the summer, the whole tree is again badly infested.

Another essential aid to aphis control is to remove and burn all prunings. The twigs, etc., pruned from an infested tree more often than not bear eggs, and when these eggs hatch in late winter the larvae find their way to the nearest tree to feed upon the opening leaf buds. To kill every egg and larva upon every tree, and yet leave egg-infested twigs lying on the ground close to trees after pruning the orchard, is but little better than half-success.

Spring and Summer Treatment.

A study of the life history of the green aphis shows that, if the infestations are to be checked effectively, in spring and summer, treatments must be made early in the season. If not controlled before the second generation appears the infestations will spread rapidly over the orchard, due to the ability of the winged females of this generation to fly from tree to tree. Special measures, therefore, should be directed against the larvae hatching from the winter eggs. Infested trees should be treated with a dependable contact insecticide early in the season before the sucking of the lice causes the leaves to curl and twist up. After the leaves are curled around the insects it is next to impossible to get the spray into contact with their bodies and the most thorough spraying will fail of effectiveness. The alert orchardist for these reasons will go out to get the wingless lice of the first generation. It will pay him to make a tree to tree inspection, locate the infested trees and rid them of the aphis rather than to wait until the infestation has been spread about by the flying aphis of the second generation, and then depend upon getting control of them by spraying his whole orchard. By then it will be too late.

One of the most generally used and effective contact spray chemicals for the spring and early summer control of orchard lice is a proprietary compound which goes under the trade name of Black Leaf 40.* Used according to directions on the container it gives perfect results *if actually applied to the bodies of the lice.* Infested limbs of small trees may be dipped into a vessel containing this solution, but larger trees necessarily must be sprayed. Spraying should be done with a nozzle having a small disc opening, so as to get a fine, misty spray.

Summary.

First. Prune your trees during the winter.

Second. Remove all cuttings and burn them.

Third. Spray thoroughly just before leaf buds open, if possible, with lime-sulphur solution under high pressure. (See instructions, page 14, for San Jose scale.) If spray is applied at this particular time add Black Leaf 40, one part to 750 parts dilute lime-sulphur.

Fourth. Summer spraying is effective only if applied before leaves curl. Watch but don't wait. Spray or dip with Black Leaf 40 according to manufacturer's directions or with fifteen per cent solution of kerosene emulsion (see directions for making, page 19).

The Rosy Apple-Leaf Aphis.

(*Aphis sorbi,* Kaltenbach.)

The rosy apple-leaf aphis, so called because of its pale pink or rose color, is common in Georgia apple orchards, though far less numerous and injurious than the green species. Individual rosy aphids are much larger. Instead of infesting the terminal growth of twigs and limbs, as does the green aphis, it shows preference for the foliage surrounding single apples and fruit clusters. The chief injury done by rosy aphis is the dwarfing and malformation of apples and, to a less extent, the inhibition of bud and wood growth. The life history of this species is, in most particulars, similar to that of the green aphis and the control measures are precisely the same (which see, page 21).

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*Manufactured by the Kentucky Tobacco Products Co., Louisville, Ky.

THE CURCULIO.

(*Conotrachelus nenuphar*, Herbst.)

The curculio, a beetle whose diet includes a wide range of fruits, among which is the apple, is best known in this State for the losses it annually causes peach growers. The peach is one of the favorite foods of the curculio and a chosen medium for the reproduction of the species. Until recent years, when the introduction of arsenical spraying effectually accomplished curculio control, the beetle was the cause, directly or indirectly, of large yearly losses to the commercial peach grower. The peach industry has been incalculably benefited by the discovery of the effectual means at present in general practice of minimizing the destructive activities of these insects. But so persistent and pernicious are its attacks that failure to take the necessary steps to curb them is inevitably costly to the grower.

In the case of the apple, curculio habits lead to results of entirely different character, both as relates to the apple and the insect itself. The attack upon the apple but very rarely causes the complete loss of the apple. And, by the same token, the insect's efforts to propagate in apples meet with failure. The female freely deposits her eggs in them, a considerable proportion of which eggs hatch into larvae, but, unlike the larval development which follows hatching in peaches, only extremely negligible numbers survive. Eggs and larvae succumb to the pressure exerted upon them by the rapid cell formation and growth of the apple, which crushes them to death in their cavities and channels. The only damage is that arising from the distorted growth and surface blemishes which invariably follow punctures made by the beetles either for feeding or egg laying. As a medium of perpetuation of species, therefore, the apple, in Georgia, is fatal to the curculio, but the damage caused especially by the egg punctures is sometimes quite serious. This damage is greater in years when the crop of peaches and other stone fruits in which curculios preferentially feed and breed has been destroyed by frosts, freezes or other causes. In the absence of a preferred fruit, the beetles are forced to turn to the less attractive apple, with the result that this fruit suffers to a proportionately greater extent.

Description and Life History.

Since the curculio does not succeed, except in the rarest instances, in completing its life cycle in the apples of Georgia, only a brief description of the insect and its life history will be made here.

The beetle is a member of a family of weevils conspicuous for the destruction they work in cultivated and stored crops. The cotton boll weevil, which closely resembles the curculio, is a near relative, and the identity of the two is frequently confused by those who are not familiar with their differences.

The adult curculio is a weevil about one-fifth of an inch in length and is armed with a proboscis, or snout, from a third to a half as long as the insect itself. The basic color is black or slate gray, marked with touches of dull yellow and white. The back is ridged and irregular and bears two well developed humps besides several minor prominences. Owing to the habits of the beetle it is seldom seen on the tree by even the most careful observer. This is due to its natural shyness as well as to the fact that it is relatively inactive in exposed places during the day. A peculiarity of the weevil is that it resorts to so-called " 'possum" tactics to escape detection or capture, drawing up its legs and proboscis tightly when disturbed and dropping to the ground in a simulation of death. At one time this well known habit was utilized to catch the beetles by jarring them from trees upon sheets spread beneath and picking them off while they were motionless and apparently dead. Jarring was found to be unsatisfactory as to results and expense, and has been abandoned as an orchard practice in favor of more effective methods of control.

Following successively the four stages in the life cycle of the curculio, there is first the egg, which is deposited by the female in a cavity she eats into the fruit for the purpose of receiving it. After depositing the egg she cuts a crescent-shape mark above and around it in the skin of the apple. The egg hatches in four or five days into a small, white, footless grub. This grub (larva) is the form of the insect known to every one and requires no description. Attaining full larval development in about three weeks after hatching, the larva emerges from the fruit, which by then has usually fallen to the ground, and tunnels its way two or three inches into the soil, makes a burrow and transforms there in the pupa. The length of the pupal, or quiescent, stage is about three or four weeks, and from the pupal case, at the end of this period, emerges the fully grown, winged beetle. There is only one brood of beetles each year, those emerging from fruit during the summer months passing the winter as adult beetles, which do not mate and reproduce until the following spring.

How Curculios Injure Apples. The principal injury which curculios do to apples in this State is the effect which the egg punctures have upon the development and appearance of the fruit and, secondarily, from the feeding punctures of the adults. Most of the eggs are laid during the first six or eight weeks after the apple begins its growth. These egg punctures are generally accompanied by the crescent-shape incision and, with the growth of the apple, the egg puncture and the accompanying incision produce atrophy or stoppage of growth at that point. The surrounding cells continue their growth, resulting in an indented, malformed apple. Later the wounds heal, but the cicatrix that forms over them is russetted and thickened. These russeted spots enlarge along with the natural growth of the apple until, by the time the latter is ripe for picking, the blemished spots are as large as or larger than a dime. Oftentimes there are several of these irregularly outlined blemishes on a single apple and they, together with the sunken areas usually a part of them, cause it to be classed as low grade fruit. Where the punctures result in badly indented and otherwise malformed apples the fruit so affected is unfit for sale.

To sum up, the only material damage inflicted by curculios is that resulting from early season egg punctures in the form of misshapen and blemished fruit. Second to this damage is that caused by the beetles in digging into the fruit for feeding purposes.

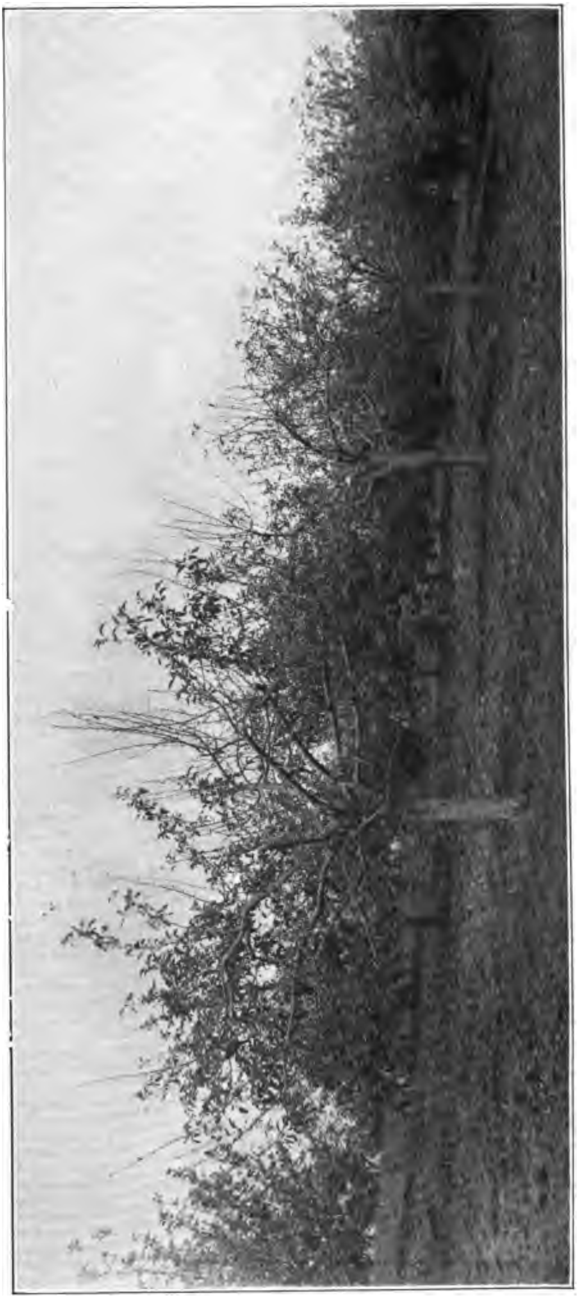
Treatment.

As curculios puncture the skin of the apple for the purpose of feeding upon the flesh within, and for egg-laying, it follows that they may be largely inhibited from making the punctures by spraying the fruit with an arsenical poison. By means of a thorough application of an arsenical just after the bloom petals are off, the apple can be rendered distasteful and relatively immune to attack. Fortunately, this spraying exactly coincides with the first, or calyx cup, spraying for the control of codling moth. Subsequent sprayings have the same schedule and formulas, enabling the orchardist to control both insects by the same means and at the same time. See schedule for spraying against the codling moth, page 9.

APPLE TREE BORERS.

Apple trees are attacked by two species of borers which directly affect their welfare and frequently are responsible, particularly in the case of young trees, for their death. The common names for these two species are the round-headed and the flat-headed borer, respectively, names derived from distinctly different physical characteristics of the larvae, or grubs. Both species are injurious to apple trees, but the flat-headed borer attacks other trees than the apple, the pecan tree being one of the chief sufferers.

PLATE I



Dead and Dying Tree Tops, the Result of San Jose Scale (Original).

PLATE II

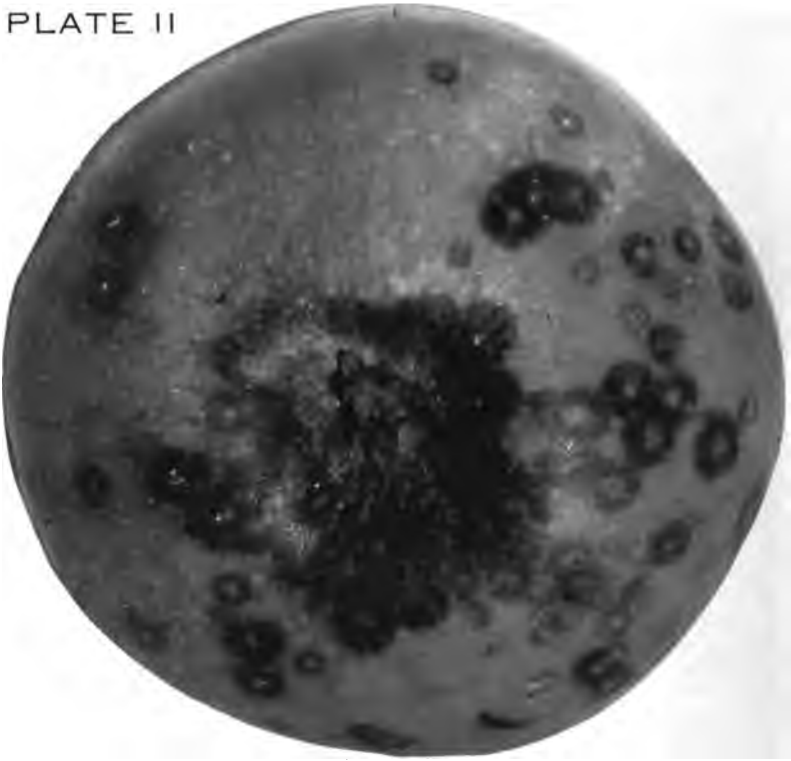


Fig. 1. Scurfy and Blotchy Apple Infested with San Jose Scale. Enlarged. (Original.)

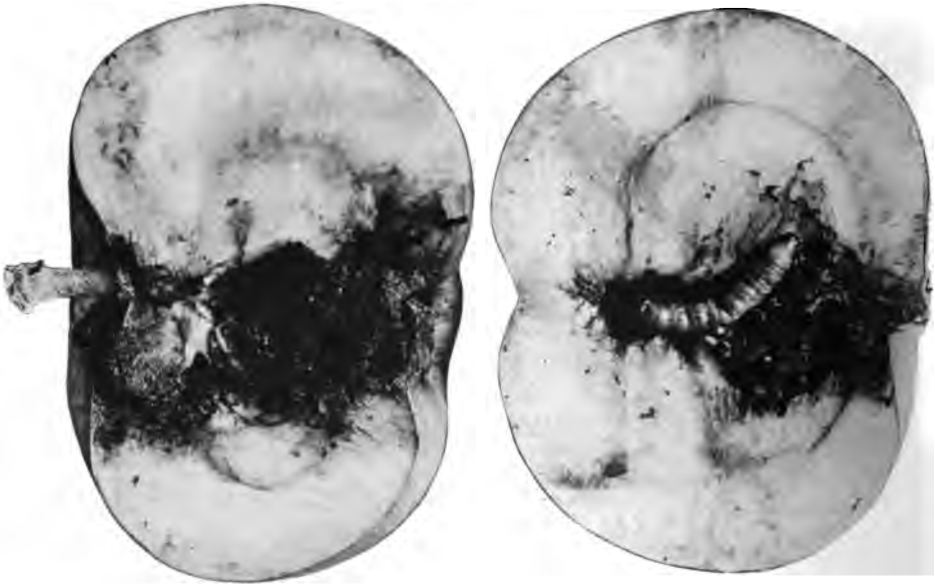


Fig. 2. Inside of an Apple Showing Codling Moth Larva and Its Work. Natural Size. (Original.)

PLATE III

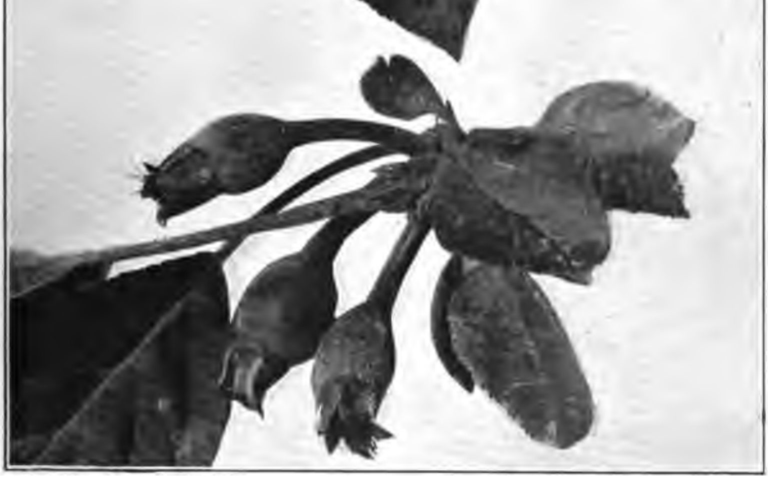


Fig. 1. Too Late for First Codling Moth Spray. Slightly Reduced. (Original.)

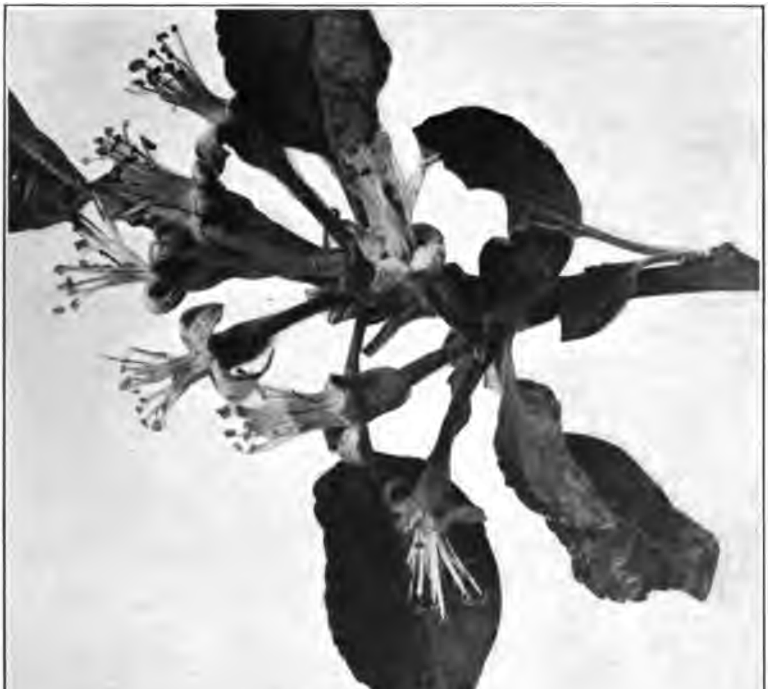
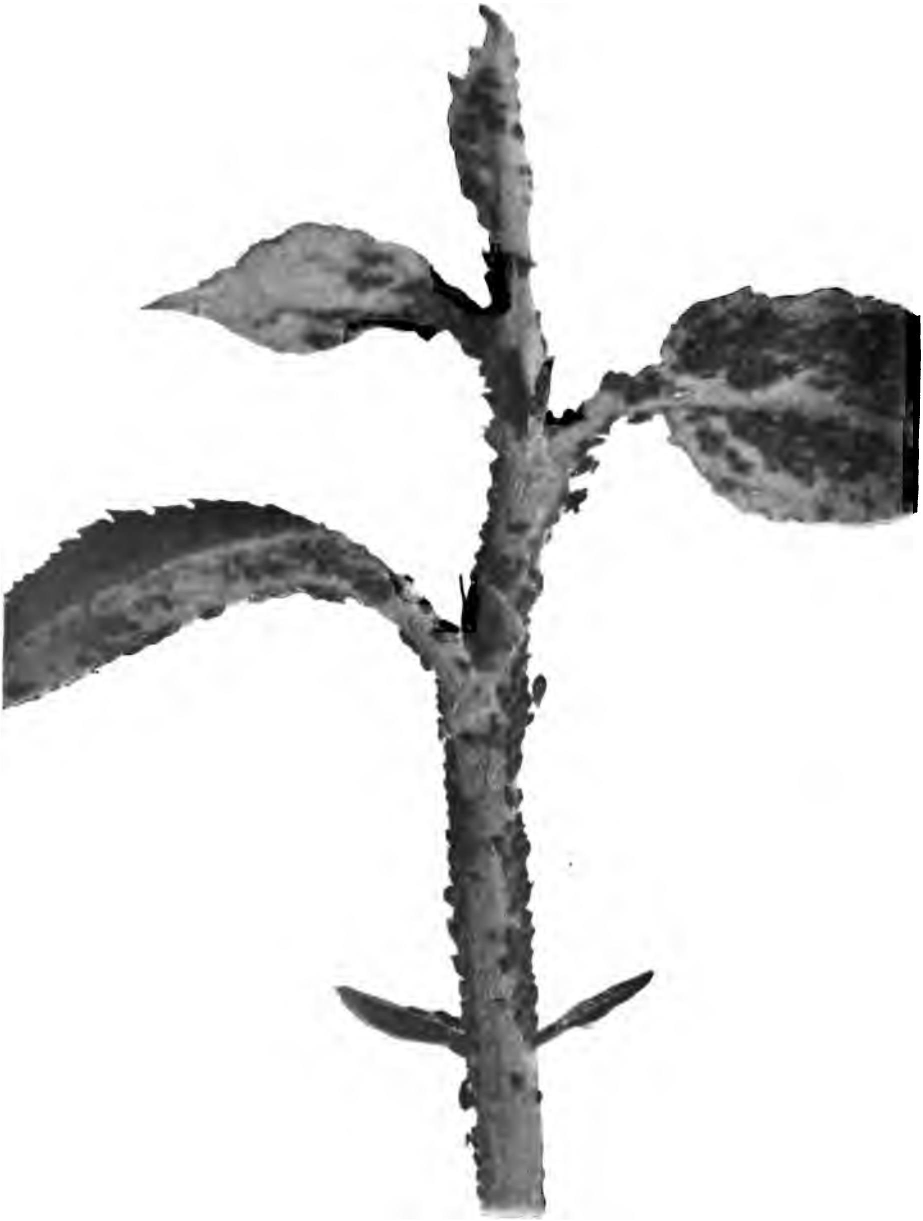


Fig. 2. Right Stage for First Codling Moth Spray. Slightly Reduced. (Original.)

PLATE IV



Green Aphis on Terminal Twig and Leaves. Natural Size. (Original.)

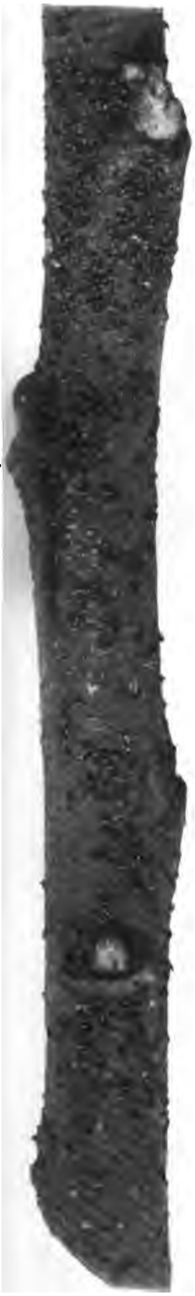


Fig. 1. Eggs of Green Aphis on Apple Twig. Enlarged. (Original.)

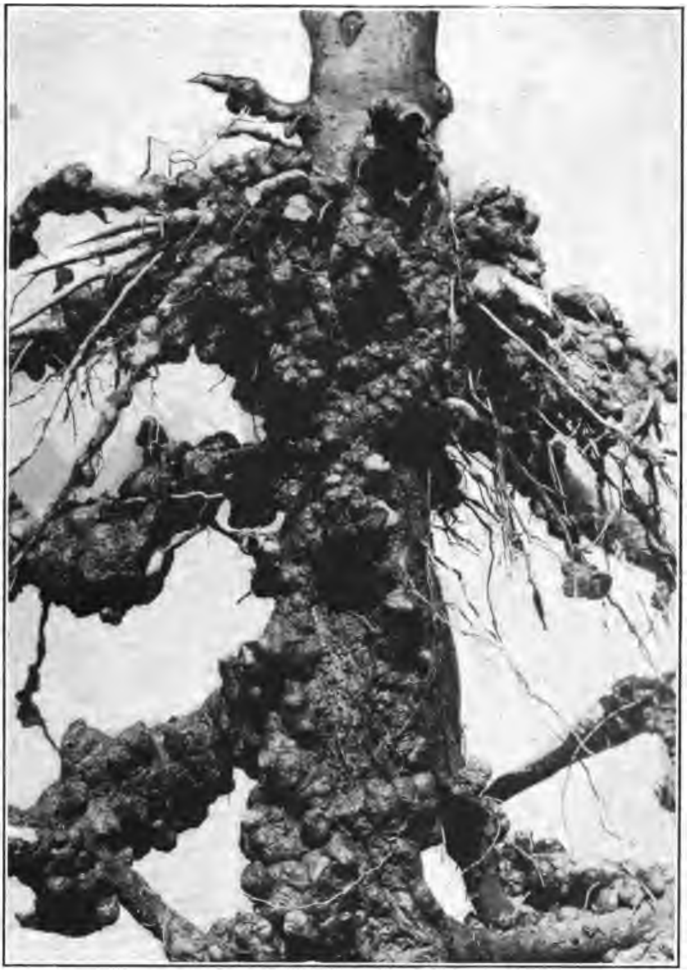


Fig. 2. Galls Resulting from Feeding of Wooly Aphis on Apple Tree Roots. (Original.)

PLATE VI

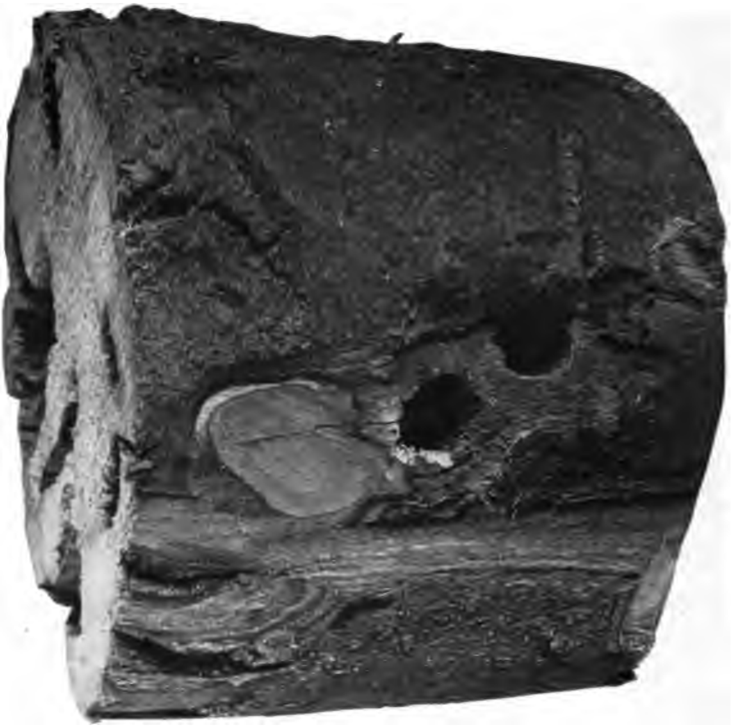


Fig. 1. Section of Apple Tree Trunk Showing Emergence Holes of Round-Headed Borers and the Larval Burrows in Heart Wood. Natural Size. (Original.)

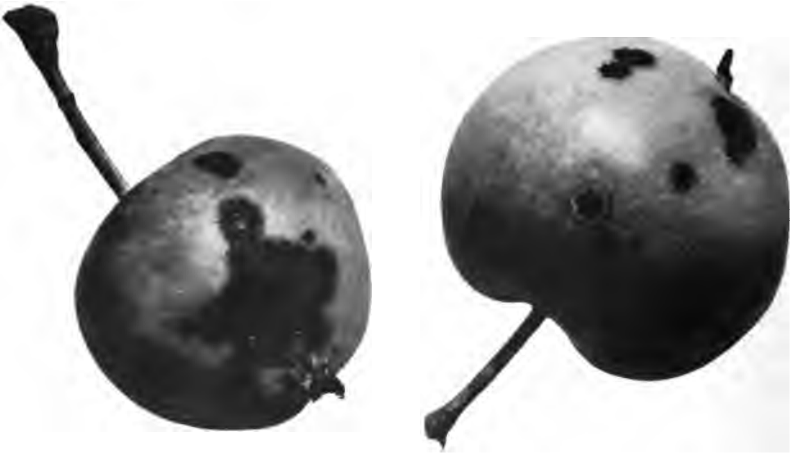
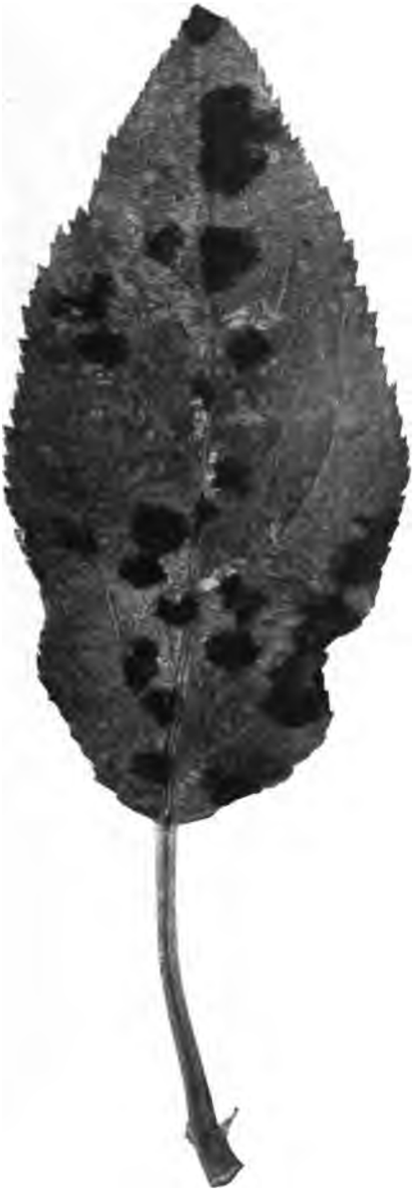
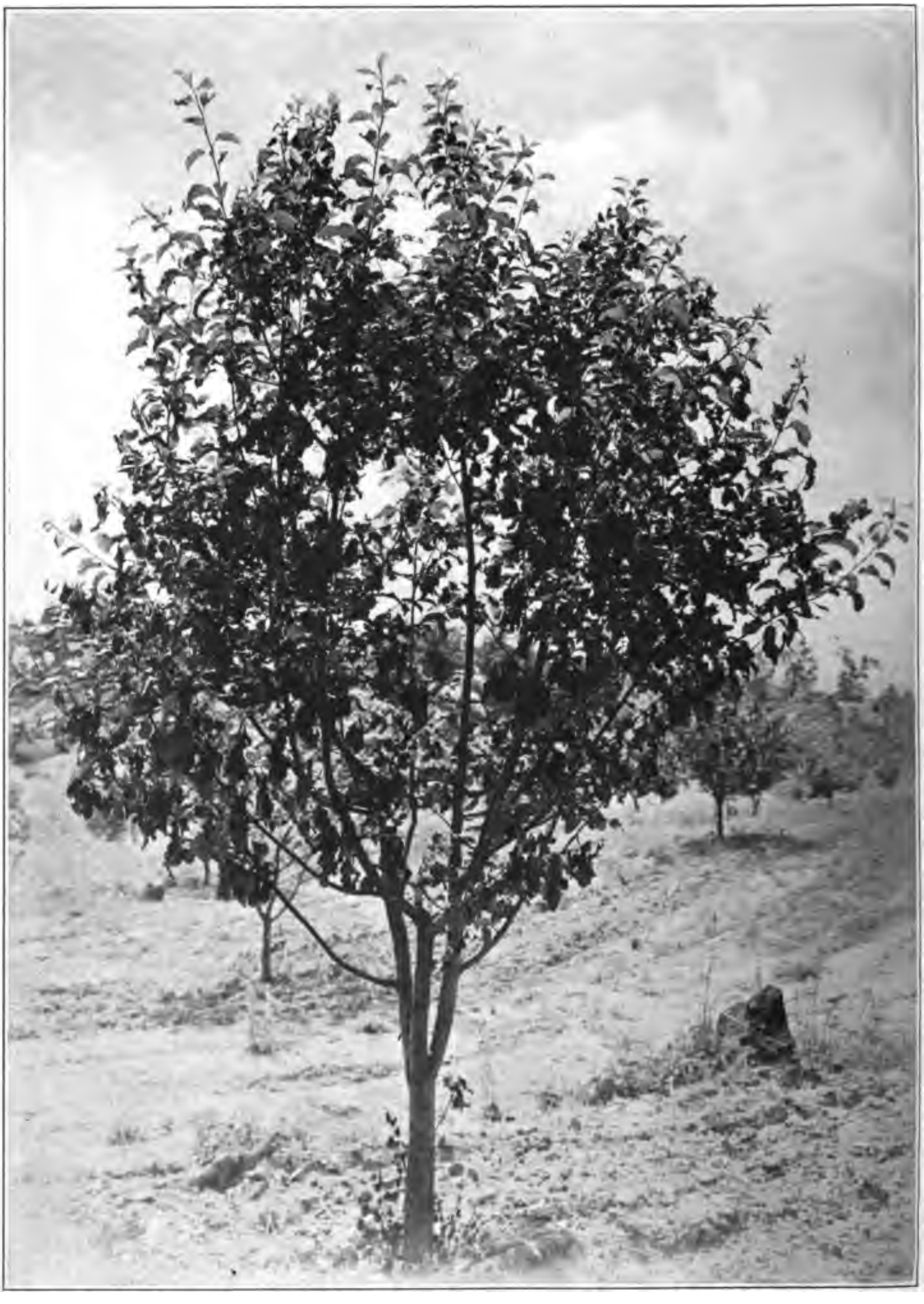


Fig. 2. Apple Scab on Fruit. Natural Size. (Original.)



Apple Scab Spots on Leaf.
Natural Size. (Original.)

PLATE VIII



Twig Blight. Note Water Sprouts Near Base of Tree, a Common Source for the Introduction of Body Blight Into Trees. (Original.)

PLATE IX

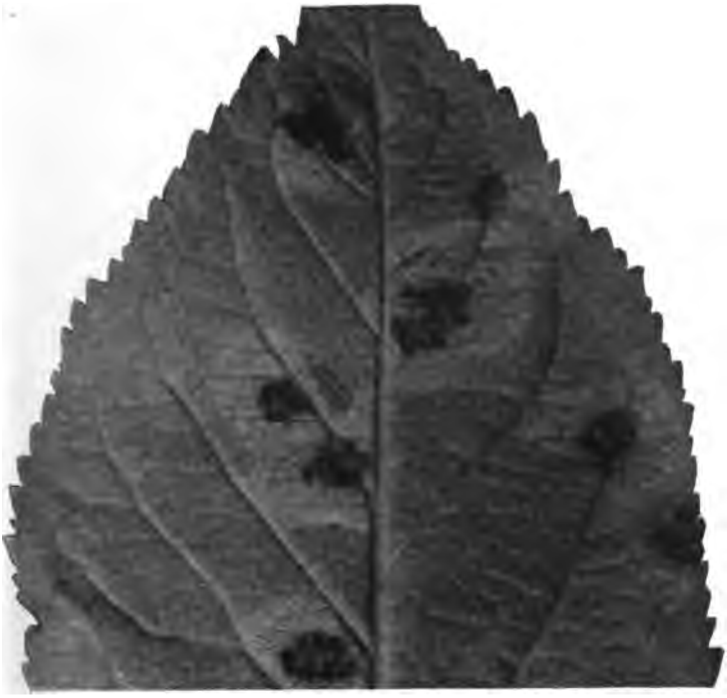


Fig. 1. **Cedar Rust Spots on Leaf. Enlarged.** (Original.)

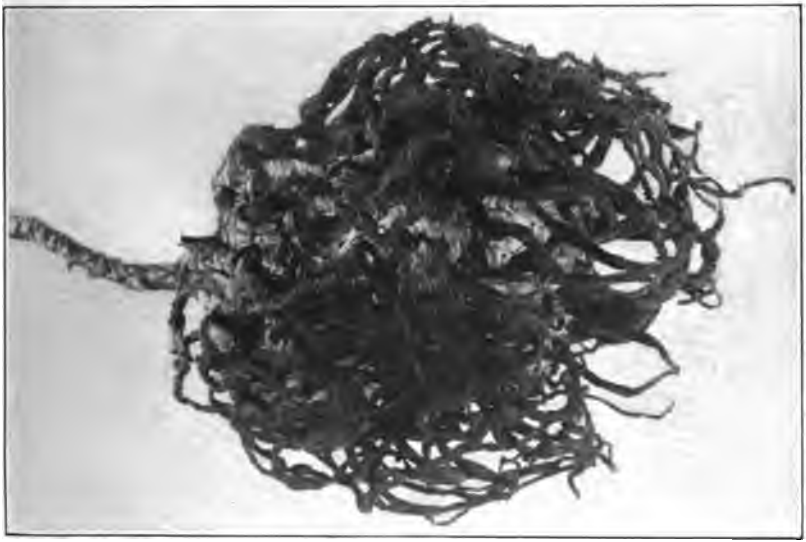


Fig. 2. **Appearance of Cedar Apple After Discharging Spores of Cedar Rust. Slightly Enlarged.** (Original.)

PLATE X

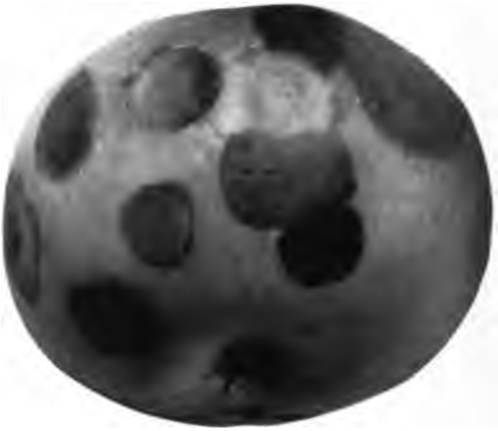


Fig. 1. **Bitter Rot of Apple. Natural Size.** (Original.)

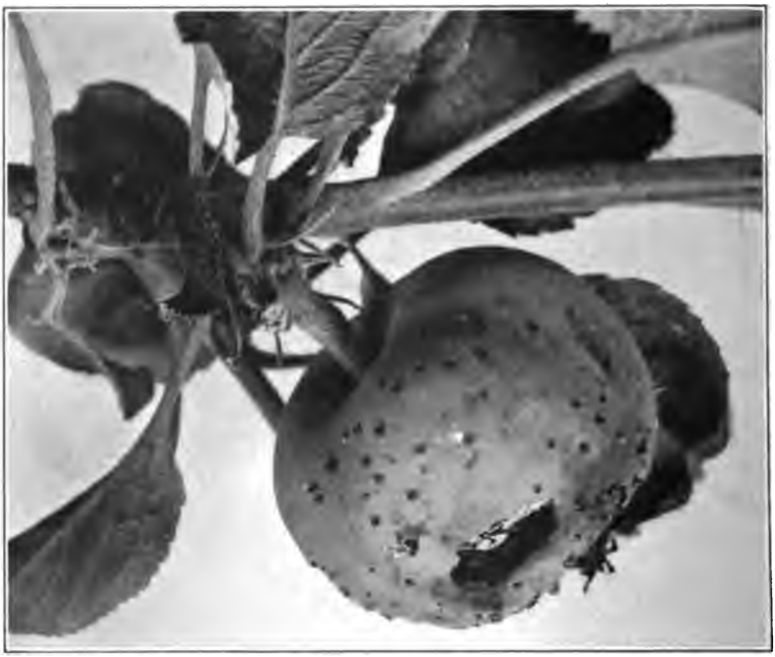
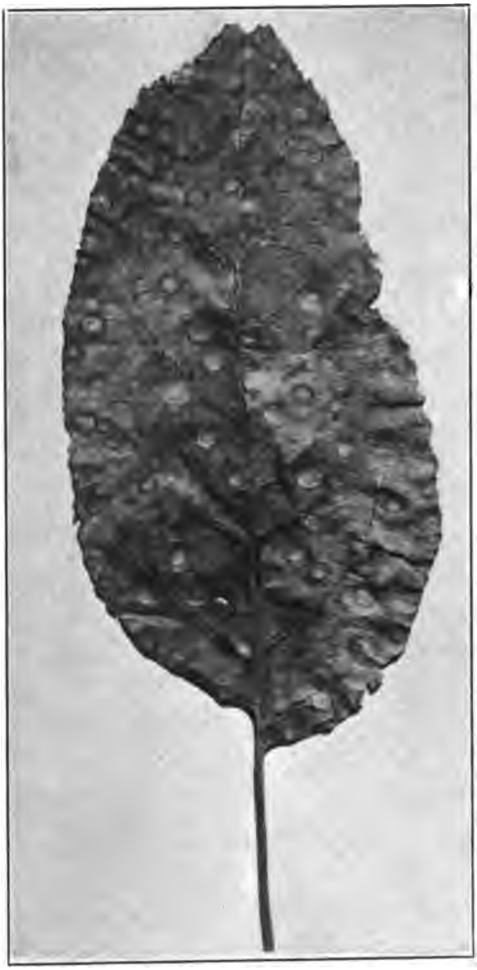


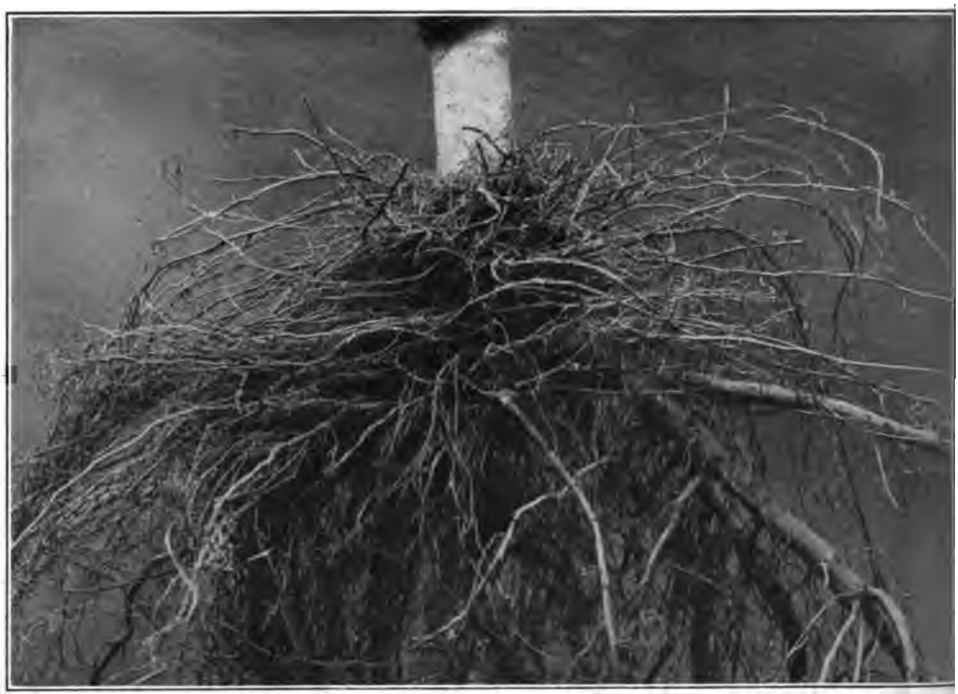
Fig. 2. **Blight of Apple. The Globules of Sticky, Bacteria-Laden Matter May Be Clearly Seen. Natural Size.** (Original.)

PLATE XI



Frog Eye Fungus or Leaf Spot
Natural Size. (Original.)

PLATE XII



Crown Gall and Hairy Root on Two-Year-Old Apple. (Original.)

The Round Headed Apple Tree Borer.

(*Saperda candida, Fab.*)

The adult of this species is a large beetle, nearly an inch in length, yellowish-brown above and silvery white beneath. Two broad, slightly curved white stripes traverse the entire length of the back. The larva is a large, footless, pale-yellowish grub, about an inch long when fully grown. The head is darker than the body and slightly larger in diameter, the larva tapering from segment to segment from its head back, the last segment being the smallest. The pupa is a trifle shorter than the larva and looks not unlike the adult.

The adult beetles appear in May and June, and shortly after emergence the females begin the deposition of eggs. These are deposited in slits cut in the bark near the base of the tree. The egg hatches in two or three weeks into the larva, which at once tunnels its way into the bark and feeds on the sap wood during its first year, cutting a disc-shape burrow. At the bottom of this burrow it passes the winter, not renewing feeding until the spring of the second year. The burrow is greatly enlarged the second year and the castings of the larva are thrust out of holes which it cuts in the bark. The trunk of small trees is often completely girdled by or before the close of the second season. The larva increases rapidly in size in the second year of its growth and its burrows begin to be extended below the sap wood into the heart wood. The second winter is passed deep in the burrows. The third spring and summer the larva penetrates still deeper into the heart wood and attains its full development therein. See fig.. 1, Plate VI. Finally it forces its way back to a place just beneath the bark, where it forms a pupa. From this pupa the adult beetle emerges the following May or June.

Appearance of Infested Trees. The presence of the round-headed borer is usually not detected until its second summer. Its presence may be identified by the discolored, sunken patches of bark marking the burrows beneath. These infested areas are sometimes marked by the exudation of sap from the wound but more often by the castings thrust out of slits in the bark. The areas of egg-laying and larval activity are almost invariably in the trunk, within a foot or eighteen inches of the ground. In small trees frequently and in large trees occasionally, the larva is found working in the crown of the tree below the level of the ground. One or more larvae in a small tree in the majority of instances will completely girdle and kill it. In older and larger trees the injury is not always fatal, though the growth of the tree and its general vitality are seriously impaired.

Remedies.

The borers are readily removed by a knife or killed by prodding into their burrows with a wire. Where several borers are in a tree the free use of the knife is not advisable, owing to the unavoidable mutilation of the tree. The safest, surest method is to tap the channel by means of a small hole and inject a few drops of bi-sulphide of carbon with a medicine dropper. The fumes of this poison are deadly to the larvae. The gas penetrates to all parts of the burrow and instantly kills the larva within, making it unnecessary to cut into the bark or wood to locate and remove, or kill, the borer. Wherever possible it is best to avoid the use of the knife in favor of gassing the larva with bi-sulphide of carbon. After injecting this liquid close the hole with a bit of clay mud to prevent the escape of the gas. Owing to the highly explosive nature of carbon bi-sulphide it should be kept well away from fire or flames that might cause it to explode.

The Flat Headed Apple Tree Borer.

(*Chrysobothris femorata,* Fab.)

The adult flat-headed borer is smaller than the adult of the round-headed species, being only about one-half inch in length. It is a beautiful, burnished beetle, reflecting bright metallic colors in which green, black and bronze predominate. The body is flattened, and tapers at the posterior end. They make an early appearance in the spring, eggs are laid, and from these eggs hatch larvae which mature in one year, issuing forth as adults the following spring. The larva tunnels first into the sap-wood, but later bores into heartwood, working back to the bark in the spring and pupating. Sometimes the winter is passed as pupae. In making their escape from the tree they cut an elliptical hole, differentiating the species from the round-headed borer, which cuts a circular emergence-hole.

Nature of Injury.

This species is more injurious to young apple trees than to old, bearing trees. The larva generally works in the trunk, and goes higher up from the ground, often to the first lateral limbs. It is not unusual to find them working in the roots of young trees, however, some inches below the surface of the ground. Infestations are detected by the patches of discolored, sunken undermined bark. Generally speaking, this borer does not show a preference for trees of vigorous, unimpaired growth. They usually come as a secondary attack upon a weakened, devitalized tree, but when these are lacking sound trees are attacked.

Remedies.

The control measures for the flat-headed borer are the same as for the round-headed species. The trunks of trees are sometimes painted with deterrent compounds to discourage the egg laying of both species, and not without success. Among these are whale-oil soap, carbolated soft soap, etc. They should be applied early in the spring as thick pastes, and renewed at intervals throughout the summer.

Worming is the most dependable method of control. It should be begun and finished during the month of September. By then the larvae are about an inch long, and the outward symptoms of their burrowing can be plainly seen. If the trees are wormed at this season the larvae may be removed with only minor injury in cutting them out.

BITTER ROT.

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(*Glomorella rufomaculans*, Berk. and S. and S.)

Of all the diseases of the apple, bitter rot ranks well in the forefront of those mostly to be feared and fought. It is the most insidious of the diseases to which the fruit is heir because of its erratic behavior. Like lightning, it sometimes comes out of a clear sky, as it were, laying waste, in a few days or weeks, the most promising harvest prospects. Very few if any advance warnings of its coming are given, and the only effective campaign that can be waged against it is that of prevention. Once well started, an outbreak may not be wholly stopped and, at best, only checked. The fact that the disease does not appear to a destructive extent annually, that the outbreaks are more or less sporadic and come without warning, inclines the grower to take a chance of its non-appearance and to dispense with preventive sprayings. The acceptance of this chance is of the nature of a gamble and is often followed by the loss of all or a large part of the crop of certain varieties of apples. It is always the part of wisdom and economy to prepare each year for the possible appearance of the disease.

Weather conditions have an important and inseparable bearing on bitter rot epidemics. Hot, muggy, or showery weather in summer is the largest and most important factor in the development and dissemination of the fungus. Where such weather conditions obtain for any length of time or at frequent intervals, bitter rot is almost certain to develop. Rains make for the spread of the rot by washing the spores from decaying apples to sound apples, communicating the disease to them in turn.

Character, Cause and Effect of Bitter Rot.

Bitter rot is caused by a fungus organism and not by wet weather, as many growers believe. Rains and heat are favorable to it, however, and the fungus flourishes when the days and nights are hot and humid. The rot does not usually begin to appear on the fruit until the early part of July and its development and spread is largely dependent at that time and during the remainder of summer on local weather conditions. It makes its first appearance on the apple as very small, brownish-colored specks beneath the skin. These minute specks enlarge rapidly, assuming a circular outline. A diseased spot, once started, increases in size very rapidly, the infection radiating out by concentric rings on the surface, and the mycelium of the fungus, at the same time, sinks deeper and deeper into the flesh, involving the tissues in a soft, watery, brown, cone-shape decomposition. The circular rotted areas quickly become sunken, with clear cut margins. Small black spots soon begin to appear beneath the skin of the diseased areas and these later break through and give off the spores, or seeds, of the fungus. The spore masses are pink in color and are easily blown off when dry or washed about on the tree by rain. Finding a receptive host, they set up a new infection, and thus the disease is passed along. Infections are most readily made through breaks or abrasions in the skin of apples. The spores therein find a resting place and the fungus immediately effects its entry and growth in the tissues. Quick and complete decay follows. Insect punctures, particularly those made by curculio and codling moth, have a direct relationship to the extent and virulence of bitter rot outbreaks.

The fungus passes the winter upon the limbs in the cankers which it forms when the bark becomes infected, and in mummied apples on the tree and ground. Bitter rot cankers are cracked, depressed portions of bark. Beneath the cankers the wood dies and cracks. Severe bitter rot epidemics may occur with or without the noticeable presence of this form of the disease.

Varietal Resistance.

It has been thoroughly demonstrated that some varieties are more resistant to infections of this disease than others. The factor of varietal resistance has not been fully worked out in Georgia, except as to a few varieties. Ben Davis and Gano are apparently the most susceptible of the commercially planted varieties and, to a less marked degree, Kinnard's Choice, Delicious, Winesap and Stayman.

Treatment.

The experimental work for the control of bitter rot in Georgia has been along the same general lines as that conducted elsewhere. A number of materials and formulas have been tested in varied spray schedules. Dispensing with details, the best results so far have been obtained from spring sprayings with weak solutions of lime-sulphur solution followed, in the middle and latter part of the season, with Bordeaux mixture. This schedule has consistently resulted in minimizing losses from bitter rot outbreaks, even among the more susceptible varieties, while, at the same time, the check or untreated trees were ruinously infected.

Prepared lime-sulphur solution, though itself a fungicide of some merit, is not the equal of Bordeaux mixture as a preventive of bitter rot. The application of Bordeaux to young apples causes them to russet, however, hence its use in the early part of the season is to be avoided. The first application of Bordeaux should not be made before about the tenth to fifteenth of June. No material russeting results from applying it at that time or later. A high degree of bitter rot control will follow the exclusive use of lime-sulphur solution as a summer spray when applied to varieties resistant to bitter rot, but no dependence is to be placed in it in relation to the control of the disease on susceptible varieties. The treatment of such varieties should be a combination of lime-sulphur sprayings in the forepart of the season with Bordeaux in the latter.

Beginning about the tenth or fifteenth of June, two or three or more applications of Bordeaux should be made at intervals of not more than three weeks. The spray schedule will vary somewhat, according to the ripening period of the variety, its susceptibility to rot, the season, etc.

In view of the manner in which Bordeaux corrodes or russets the skin of fruit the formula should not be more concentrated than 4-4-50 if three or more applications are to be made, that is, bluestone four pounds, lime four pounds, water fifty gallons. Arsenate of lead or its equivalent should be added to each Bordeaux application as a protection against codling moth, curculio and other biting insects.

The removal of all mummied apples from the trees and ground, and the removal or disinfection of cankered limbs are valuable aids to bitter rot control.

Method of Making Bordeaux Mixture.

Copper sulphate (bluestone)	4 lbs.
Fresh lump lime	4 lbs.
Water to make	50 gals.

First dissolve the bluestone in a wooden vessel (a keg or barrel) containing 25 gallons water, by suspending it in a sack or bag so that it will just be submerged beneath the surface. Slack the lime by adding a little water at a time, strain it into a second barrel and dilute to 25 gallons. Pour the two mixtures together, a bucketful of each at a time, into a third barrel, letting the two streams mingle as they fall. Strain the mixture through a fine copper screen into the spray barrel or tank. Arsenate of lead, one pound of the powdered form to each 50 gallons, should be added last. Bordeaux should be kept well agitated in the spray tank to keep the precipitate from settling to the bottom.

Stock solutions of bluestone water and lime water, if prepared in advance, will save time and labor in extensive spraying operations.

APPLE SCAB.

(*Venturia pomi,* Wint.)

With the single exception of virulent epidemics of bitter rot, no disease of the apple is of more economic importance than apple scab. In orchards where no measures are taken to prevent or control it, scabby fruit may easily, and often does, outnumber the scab-free by two to one. Sometimes the ratio is even greater. Diseased apples, in extreme cases, are small, malformed, and often cracked and worthless. Lighter attacks, while not stunting or splitting, lower the market value of the fruit.

Description and Nature of Injury.

Apple scab is caused by a fungus which lives upon the leaves and fruit in summer and, to some extent, upon the twigs, and in the winter upon fallen leaves. The character and extent of its ravages are well known to observant apple growers. Scab grows upon the fruit as roughly circular, dark gray or olive brown spots. The size of individual spots varies from tiny specks to blotches a half-inch in diameter. Frequently two or more scab spots join and extend a united development over the skin. In this way nearly all the epidermis of an apple may eventually become scabbed. In such well developed attacks the apple usually cracks open and, when not dropping prematurely, is of no value whatever for purposes of sale at maturity.

The fungus also attacks the foliage, causing the same olive-brown discoloration common to its early stages on the apple. Plate VII, Most of the infections of the leaf are confined to the under side, the fungus rooting and growing more readily in the pubescence there than upon the smooth, glaze-like upper surface·

The development of apple scab is concomitant with the development of foliage and fruit in spring. The fruit buds are often destroyed in large numbers at this season and, when the leaves are also severely attacked at the same period, the trees are almost denuded of foliage by May. Cool, wet weather is favorable to the development and spread of scab infections. For this reason it is most active and destructive in spring and in the rainy seasons of early summer. Since cool, wet weather favors the disease and dry, sunny days in spring are distinctly unfavorable, it is easy to account for the greater prevalence and destructiveness of scab one season over another. Also, the annual rainfall in any given locality, together with the average temperature, prevalence or absence of fogs, have a direct bearing on the occurrence or non-appearance of scab epidemics. As a general average, one year after another, scab does not occasion any loss to the Georgia apple grower, except, perhaps, in the more mountainous sections where the rainfall is greater, the springs colder and the fogs more usual, than elsewhere in the apple-growing belt.

Treatment.

As destructive as the disease may be on occasion, it readily responds to preventive sprays. Prevention is the surest protection, but the preventive treatment must be applied at precisely the right time to be of maximum value. It is next to impossible to check the defoliation of the tree and the scabbing of the fruit after the infection has gained a good start and weather conditions are propitious for its continuance and spread. Protection lies in taking out spray insurance.

The writer has experimented for the past several years with the lime-sulphur concentrate as a preventive spray against scab. In these tests uniform success was obtained in every case where the solution was applied in late winter, just before the leaf buds opened, at the concentrated dilution recommended on page 16 as a control for San Jose scale. This late winter treatment, followed by the addition of a weak dilution of lime-sulphur to the first and second applications against codling moth, constitute an effective schedule for the prevention of apple scab.

Spray Schedule for Apple Scab.

First. Spray just before leaf buds open with lime-sulphur concentrate at the dilution recommended on page 16 against scale.

Later Sprayings. Same schedule as for codling moth and bitter rot. (See page 9.)

CEDAR RUST.

(*Gymnosporangium juniperi-virginianae*, Schw.)

As the name implies, cedar rust takes its title from its native host plant, the common red cedar, upon which one stage of its life cycle is spent. Infections of apples and apple foliage are transmitted directly from cedars and not from other sources. It follows, then, that orchards in sections where no cedars grow, if such coincidences exist, are not exposed to infection. Experience has shown that there is a wide scale of susceptibility of varieties to the disease. Some are practically immune while, on the other extreme, others are ruinously susceptible.

Description and Cause of Cedar Rust.

Both the foliage and fruit of apple trees are attacked, though not in the same degree. The rust appears on the upper surface of the leaf as light yellow spots and upon the fruit as more brightly colored yellow spots which frequently bear a greenish-yellow cast. Enlarging, the spots on the leaf finally attain a diameter of from one-eighth to one-quarter inch. Accompanying this growth is a gradual change in the color from light to orange yellow, and a number of minute black dots are visible in the center. After a few weeks a thickened cushion develops on the opposite side of the leaf from the diseased area. This cushion presently forms spore-bearing tubes, the ends of which split and curl backward, producing a fringed effect (fig. 1 Plate IX). Spores are produced in prodigious numbers and are carried far and widely by winds, but have not the faculty of re-infecting apples or apple foliage. All that do not fall on a cedar tree fall on barren ground. Finding the original host plant, the cedar, the spores lodge and start a new growth, producing ultimately cedar balls or cedar apples.

Infections of cedar trees arising from spores produced on apple trees develop on the twigs and result in the formation of cedar balls—round, reddish-colored, gall-like swellings, usually less than an inch in diameter. The balls begin their growth on cedar twigs in the early summer months, pass the winter there, and renew growth the following spring. Full growth is not attained until the second fall following the start of the infection. The second spring the mature balls produce spores, or seeds, in a yellow, jelly-like growth which arises from the balls after a season of wet weather. From these long gelatinous tentacles a second and smaller crop of spores is later produced. When dry, the secondary spores are of dust-like fineness and are driven by winds to apple trees, where they infect the foliage and the fruit, causing the abnormalities described above. The spores are driven great distances by favoring winds, often for miles, which accounts for the free infection of apple trees remotely distant from the nearest cedar tree.

Cedar rust on the apple appears as bright yellow spots. It occurs in the majority of cases in and around the calyx cavity. Spores are produced from the diseased areas from tubes like those occurring on the leaf. The fungus penetrates into the flesh of the apple, producing a yellow-colored, atrophied condition of the cells.

It is well known that certain varieties of apples are more resistant to the disease than others. On some varieties the foliage is worse affected, while on others it is the fruit. The principal injury is done to the foliage, which injury exerts a direct and deleterious effect upon the tree. Bad attacks give the foliage crop of a tree a yellow appearance, noticeable at a distance. The diseased leaves fall in consequence of the malady so that, in extreme cases, nearly complete defoliation is the result. The feeding and breathing functions of the plant are impaired to the detriment of the fruit upon the trees and the mal-nutrition of the fruit buds of the succeeding crop. The foliage of Ben Davis and Shockley is extremely subject to attack and the fruit of the latter suffers nearly as badly as the foliage.

Treatment.

The most certain method of preventing infections of cedar rust is to remove or cause to be removed all cedar trees of whatever size within at least a mile or more of the orchard. The source of infection in every case is the cedar, as the fungus cannot exist without at one stage of its life history reproducing thereon. Care should be taken to hunt out and destroy all cedars, both large and small, that are near enough to menace the orchard. The writer has had very indifferent success in controlling the disease by spraying. Sprayings are beneficial but do not give perfect results. The measure of success in preventing the disease by spraying is gauged by the thoroughness with which the surface of the leaves is covered in making all the regular routine summer sprays for the control of codling moth and scab.

The disease gets its start in early spring at a time when wet weather favors the production of spores and winds their dissemination. To be most beneficial the treatment should begin with the appearance of the foliage and continue at specified intervals until the leaves and fruit are well covered by a protective fungicide. The spray schedule recommended on page 2 will yield a fair measure of success against cedar rust.

APPLE LEAF SPOT.

(*Sphaeropsis malorum,* Peck.)

One of the most destructive diseases of apple foliage is known as leaf spot, or frog-eye fungus. It is more or less prevalent in Georgia every year, and in favorable seasons the defoliation produced by it is very serious. Like most fungus diseases, it flourishes best where there is an abundance of moisture. In some apple growing sections of Georgia, particularly in the more mountainous sections where the annual rainfall is high and more atmospheric moisture prevails in the form of daily fogs, the disease occurs annually and destructively. On apple trees located on low, poorly drained land, where there is improper air drainage and the moisture from dews, etc., remains longest on the leaves it is common to find the most severe outbreaks of the fungus. These attacks are renewed at intervals throughout the season during protracted spells of wet weather.

Description.

Leaf spot (Plate XI) is another apple disease appearing soon after the leaves are out in spring. As a general rule its period of greatest activity is confined to spring and early summer. The first indication of it on the leaf is a small, grayish, circular spot. When the diameter of this spot has reached about one-eighth of an inch a well-defined, dark brown, raised margin is developed. Numbers of spots appear simultaneously on the leaf. A single mature spot has a diameter varying from one-eighth to three-quarters of an inch, or more. At the center of each diseased area there is a grayish white spot about one-eighth inch in diameter. Several raised, concentric, grayish or brown rings may form at irregular intervals in the muddy brown diseased tissue beyond the frog-eye center. The circular growth of the center spot is often modified in the outer margin, becoming lop sided. None of the above characteristic markings, with the exception of the frog-eye nucleus, is clearly defined on the under surface. The coloring of the latter is a uniform dark brown, punctuated by the round and lighter colored frog-eye spots above.

Cause of the Disease.

Leaf spot is caused by a fungus organism which lives over winter on fallen leaves and in cankers on the limbs and trunks of the tree. In the spring seed spores are produced from these sources which, falling on young apple leaves in the presence of moisture, germinate, penetrate and grow in the leaf tissues, causing the spotting described above. It is true of leaf spot as it is of apple scab that epidemics do not recur annually and that the destructiveness of the disease is determined mainly by the weather conditions prevailing during the early part of the growing season.

Treatment.

The treatment prescribed for the control of bitter rot, scab and codling moth (p. 9) will also be found effective against leaf spot. To obtain the maximum prevention of the fungus it is desirable, whenever possible, to apply the dormant spray of lime-sulphur concentrate just before the leaf buds open. Fertilization and clean cultivation tend to limit the liability of the tree and its foliage to infection.

The regular winter treatment for the control of San Jose scale, if applied immediately prior to the opening of the leaf buds, and followed throughout the season by the spray schedule recommended for the control of codling moth, etc· (p. 9) will reduce leaf spot to negligible proportions.

BLIGHT.

(*Bacillus amylovorus*, Burrill.)

Apple trees are subject to attack by still another disease known under the name of fire blight or pear blight. This disease is especially fatal to the pear, although the apple is a close second in point of susceptibility and the injury sustained. The disease on the latter assumes several forms which are known severally to orchardists as blossom blight, twig blight, hold-over blight, and body blight. All of these forms are manifestations of the one disease, fire blight, and are caused by the same germs working in the same manner. Due to the fact that it is the sap and sap wood which are principally affected the disease is not subject to control by spraying. The most dependable way in which it can be controlled is by a policy of persistent pruning of affected parts when an attack occurs and develops. Not only must this pruning be done promptly, but there is a certain procedure to be followed in the pruning and precautions to be taken in the actual removal of infected wood.

Blight epidemics do not appear destructively every year. It is a disease peculiarly influenced by the weather and temperature and as the favorable influencing factors do not always recur in successive seasons, there are seasonable variations in the extent and destructiveness of blight outbreaks. Wet, cool weather favors the disease and dry, sunny weather effectually destroys the germ and checks the progress of an outbreak.

Description and Life History.

Blight is a bacterial disease of the cambium layer and inner bark. These parts are so intimately and closely associated with the sap current that the rapid spread of an infection in spring and summer is readily accounted for. The causal organism is a bacterium and not a fungus. The first evidence of its presence in spring is usually noted when the trees are in bloom. The blossoms are attacked and quickly wilt, and turn brown. Blossom blight is the form of the disease which sometimes causes the loss of a whole bloom crop in acute cases. Bees and other insects, attracted to blossoms to feed upon the nectar, carry away to healthy flowers the germs from diseased flowers on their mouth parts, legs and bodies, and in this way what might otherwise have been an attack of minor importance becomes a general epidemic.

Twig blight is caused by the bacteria working down in the sap and cambium layer from the tips of twigs and from blossoms into the healthy wood below. As the disease progresses downward it is followed by the wilting and brown discoloration on the leaves. Specimens of twig blight are illustrated by the tree shown on Plate VIII. The infection of a terminal twig often extends downward into the main limbs and trunk, killing the bark as it goes. Whenever and wherever a twig, branch or trunk is girdled by the spread of the bacteria the fate of all growth above the girdled area is sealed.

Hold-over blight is a manifestation of the disease found in spots mainly upon the trunk and branches. It is this form which carries the disease over from season to season. These areas are reddish in color and the contrast and appearance with the surrounding live bark is so marked that they may be detected and the infected areas removed. In the spring, with the rise of the sap, the hold-over blight areas exude globules of a sticky, viscid matter which is literally crowded with the germs of the disease. This substance is a favorite food for sucking insects, such as bees and aphis, and in feeding upon it and subsequently removing to, and feeding upon, blossoms, healthy wood or fruits, the disease is transmitted. The blight infected apple, showing the sticky, germ-carrying globules is shown in fig. 2, Plate X. On this particular apple aphis were found moving about and freely feeding and it affords a striking instance of the manner in which these insects transmit the disease from point to point.

Control Measures.

The best known, and perhaps the most dependable, method of controlilng blight is by the cutting off of diseased parts in the spring and summer and the removal and disinfection of the hold-over live blight cankers which occur on the limbs and trunk of the tree. The proper time to locate and remove these infected spots is in the dormant season, preferably in late fall just before the leaves drop, at which time the contrast between diseased and healthy wood and foliage is more marked, and the location of the cankers, etc., easier. A careful search should be made again in the spring just before the buds open, to locate all hold-over blight infections, as the elimination of this form has an important and inseparable bearing on the following summer's infection of blossoms, twigs, and fruits.

The summer pruning of blight diseased twigs, etc., should not be undertaken unless precautions are taken to disinfect the pruning instruments after each separate cut. If not so disinfected the germs will become attached to the instrument and so be transmitted to healthy tissue in succeeding cuts. The pruning instrument, whether it be shears, saw, or knife, should be disinfected by dipping in a germicide, or by carefully wiping with a cloth saturated therein. In removing a diseased part the cut should be made fully ten or twelve inches below the lowest visible sign of the disease. The cutting-out of hold-over blight cankers during the dormant season should be followed by the disinfection of the knife after each separate operation and the wound disinfected by painting with creosote or the thorough application of other disinfectants. Pruned parts should be burned at once.

As blight shows a preference for tender, succulent wood growth and is frequently carried into the trunk of a tree by water sprouts, etc., which grow at, or near the base of a tree, it is highly important not to allow this growth to form and continue below the first main lateral limbs. Many trees are killed by blight girdling the trunk after having been infected through the medium of water sprouts, etc.

Disinfectant solutions, etc. Use a 5% solution of formalin, or corrosive sublimate (bichloride of mercury) one part to one thousand parts of water, or creosote.

APPLE CROWN GALL.

Nominally, crown-gall is well known both to the nurseryman and the orchardist. Considerable confusion exists, however, as to the forms of the disease, their peculiarities of growth, the extent of injury to the tree, their communicability in nursery rows, and the orchard. It is the purpose of the following brief discussion of the disease to set forth a few of the most pertinent facts in connection with both forms, in the hope of clearing up the confusion relative to them in the minds of apple growers.

Distribution.

Crown-gall is common to all parts of the United States. So far as is known the distribution is fairly uniform, so that no state or section of state can lay just claims to more freedom therefrom than any other State or section. It is present, in greater or less quantities, in all nurseries, and, lacking a cure, a variable percentage of diseased nursery stock is always discarded by the careful and honest nurseryman in the annual marketing of his trees. On the other hand, unfortunately, the indifferent or unscrupulous nurseryman will undertake to foist gall-diseased trees on his customers and too often the victim is unaware of the unfair dealing.

Description of Crown-Gall and Hairy-Root.

One of the results of Hedgcock's investigation of crown-gall* was the separation of the disease into two distinct classes, namely, the hard form, which is crown-gall proper, and the hairy-root form. Both forms are familiar to nurserymen and orchardists. The hard form causes a gall or knot of cork-like hypertrophied tissue. The galls are largest just at the crown of the tree, and the lateral roots bear smaller galls. The hairy-root disease may or may not occur in conjunction with crown-gall. It is characterized by the development of thick, matted masses of fine fibrous roots (Plate XII). More often than not, there is an entire absence of healthy, lateral feeding roots. When galls accompany hairy-root they are not as another manifestation of the disease, but result from wounds.

Two Kinds of Crown-Gall.

Aside from hairy-root of apple trees there are two forms of crown-gall. These are differentiated by the titles hard and soft, respectively. Quoting from Hedgcock:

> "Apple crown-gall is of two types—a hard, callous form is common on grafted trees at the union of root and scion, and at any other point of the root system where wounds occur in either the cultivation or transplanting of trees. The results of extensive inoculations with this type have failed to prove that the disease is of a contagious nature."
>
> "A second type is a soft form more common on seedlings, resembling those of the raspberry and peach, in that they are soft and often rot off. It is not certain, however, that they, like the latter, are replaced the following year by a new gall growth from the adjacent live tissues of the host, nor is there proof that they are of a contagious nature."

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*Bulletin 90 Bureau of Plant Industry, 1906.

Remedies.

No certain cure for crown-gall is known. It may be lessened in the nursery by propagating trees by budding instead of grafting. The wounds made in the seedling stock to insert the scion offer ideal conditions for the entrance of the disease, wherever propagation is by grafting, and they constitute the commonest source of infection in a nursery. It is not proven conclusively, in view of all the evidence, that minor infections of gall in nursery stock materially injure the tree after it is transplanted to the orchard, or that the disease is of a decidedly contagious character. The buyer of nursery stock should always take the benefit of the doubt, however, and examine each and every tree before it is planted with the view of detecting and discarding all trees that show visible symptoms of either crown-gall or hairy-root. If either form continues to develop after the tree is transplanted to the orchard it will ultimately necessitate the removal of the tree so afflicted. This eventuality can be anticipated by planting trees only with a healthy, whole, clean root system.

SPRAYING MACHINERY AND ACCESSORIES.

No less important than the use of reliable insecticides and fungicides is the selection of a spraying outfit. Much trouble and delay would be obviated, and the orchardist realize greatly increased efficiency from his spraying operations, if he purchased only high-grade pumps and accessories of standard, dependable manufacture and of capacity adequate to his needs.

It is the worst kind of economy to buy a cheap pump and cheap accessories merely because they are cheap. A few dollars more in the initial cost of the outfit will save themselves scores of times over. The cheaper grades of pumps and spraying equipment, such as hose, etc., are necessarily constructed of a low grade of material and will not stand hard service, nor give the same service, even when new, as the better grades. A good pump well cared for has fewer break downs, saves time and temper, and gives higher and more constant pressure, thus increasing the quality of the work and proportionately decreasing injurious insects and fungus. The same holds true of spray pump accessories. Hose should be of five to seven ply quality, extension rods of a length suitable to the height of the trees to be sprayed, etc. All connections should be kept tightly fitted to prevent leakage and attendant discomfort and loss of power and materials.

Barrel Pumps.

Pumps of this type are made to be fitted in fifty-gallon barrels. They are manufactured by a number of concerns and vary somewhat in construction. Pumps of this type and capacity are suitable for use in smaller orchards. Except in instances where one has only a few trees to spray, a barrel pump is the smallest size pump which gives satisfactory service. Bucket pumps, knap-sack sprayers and pumps of that class are of such small capacity and as a rule give such weak pressure as to make them undesirable for use upon anything except shrubs and low-growing trees.

One of the chief shortcomings of all barrel pumps lies in their failure thoroughly to agitate the spray solution. All are equipped with a device to stir the spray solution in the barrel, which device is attached to and operated by the pump handle. Such agitators do not work rapidly, or stir vigorously enough to keep the solid matter in the spray solution from settling to the bottom, resulting in extremely variable spray at the nozzle. As a consequence of this the solids will usually be pumped out before the barrel is half emptied, and the last half of the barrel will contain less than its proportionate part of the suspended solids. The agitation given by the pump handle should be supplemented at five minute intervals by stirring up the settlings vigorously with a paddle.

Power Pumps.

Gasoline power pumps are gaining in favor each year and are becoming more and more generally used. This type is the best for orchard spraying purposes and is rapidly supplanting all other types. Motor driven pumps combine three essential factors of successful spraying. They develop high pressure, maintain it constantly, and the propeller-blade agitation of the solution in the tank insures a uniform physical and chemical spray mist.

Gas driven power pump construction has been greatly simplified in the last few years and the standard makes give excellent service. None of them is quite fool-proof, however, and at least one man of the crew, preferably the driver, should understand the mechanism of the engine and pump and be responsible for keeping them clean, well oiled and in good working order. Some dissatisfaction with motor driven pumps has arisen from the fact that they are placed in charge of ignorant or indifferent operators. A little intelligent care and attention will do away with much of this dissatisfaction and complaint.

Hose.

There are only two things to keep in mind when purchasing hose: buy the best grade and plenty of it. Spraying is facilitated and better results secured by using lengths sufficient to allow the operator to work all around the largest trees. This means an average length of about fifty feet. Good hose will last with careful usage for a whole year or more of the hardest service under high pressure. Poor hose, on the other hand, quickly deteriorates and becomes useless and, even when new, will not support the high pressure generated by motor driven power pumps.

Extension Rods and Cut Offs.

Extension rods should be cut in lengths comforable to the height of the trees to be sprayed. The so-called bamboo spray rods are lighter and more easily handled and do not tire the nozzleman so quickly as the one-quarter inch iron spray rods and for this reason are preferable to the latter. Do not attempt to use them without first fitting them with cut-offs for instantly cutting off the current when moving from tree to tree or at other times. They are saving of material, and, in fact, indispensable for various reasons.

Nozzles.

Nozzles are of various types designed to meet specialized purposes. The two most common types are, first, those which throw a fine cone-shaped spray, and second, those that throw a solid stream. The former type is adapted to winter spraying against San Jose scale, etc., and all summer sprayings of the fruit and foliage except the first codling moth treatment. The latter, of which the Bordeaux and the Clipper nozzles are the best known and most widely used, is used only in the first codling moth spray (which see, page 9). All apple orchardits should have a supply of both types.

Clamps and Fittings.

No outfit is complete without an abundant extra supply of hose clamps, washers, couplings for joining hose, etc. Spraying outfits, strictly speaking, are not working properly unless the only avenue of escape for the spray solution is the aperture in the nozzle. When so working, discomforts and delays are avoided and results are effective and profitable. Too little attention is given by the average orchardist to the serviceable upkeep of his spraying equipment. This form of neglect results in frequent delays in the field and is costly in time and money.

Names and Addresses of Spray Pump Manufacturers.

The following is a list of a few reliable spray pump companies. These names do not represent the only pumps on the market; only a few of them that have been used in this State:

Hardie Manufacturing Co., Hudson, Mich.
Bean Spray Pump Company, Lansing, Mich.
Gould Manufacturing Company, Seneca Falls, N. Y.
The Deming Company, Salem, Ohio.
The Friend Manufacturing Company, Gasport, N. Y.
The Hayes Manufacturing Company, Galva, Ill.

NOTES ON CARE AND MANAGEMENT OF APPLE ORCHARDS.

Varieties of Apples to Plant.

Owing to the comparatively recent development of the apple industry in Georgia much remains to be learned relative to the adaptability of varieties to the soil and climate. This phase of the problem is yet largely in an experimental stage. Generally speaking, the standard commercial varieties can be grown here in their fullness of color, size and flavor. Following is a partial list of such varieties as have been found by experience to be vigorous growers and dependable bearers of fruit:

- Winesap
- Jonathan
- Yates
- Kinnard's Choice
- Delicious
- Black Ben Davis
- Yellow Transparent
- Stayman's Winesap
- King David
- Terry Winter
- Wilson Red June
- Red Ben Davis
- York Imperial
- Liveland Raspberry

Purchasing Nursery Stock.

In buying trees for the orchard, it is desirable to use one-year budded or grafted trees, preferably budded, instead of two-year-old stock. At one year from the bud or graft a tree is a branchless whip, and so may be cut off and made to head out to any form desired by the orchardist. In other words, they more readily lend themselves to formative pruning than two-year old trees, which are branched in the nursery rows, necessitating the selection of such of these limbs as are best suited for the frame work of the permanent orchard tree. More often than otherwise the branches of two-year old nursery trees are too high, too scanty, or so placed that they do not permit of much choice in selecting to form a well balanced head. The buyer should insist on healthy, vigorous trees, true to name. The so-called pedigree stock, if genuine, is always more desirable and is worth more than trees propagated from scions taken from nursery stock. By the term pedigree stock is meant trees propagated from scions cut from bearing wood. It has the advantage of being true to type and name, and usually fruits more quickly and is more prolific than other stock. Budded trees are less susceptible to crown-gall infection in the nursery, though they are not superior to whole-rooted grafted trees free of gall.

Laying Off the Orchard.

The laying out of the orchard necessarily must be determined in large measure by the topography of the land to be planted. It goes without saying that a regular, systematically planted orchard, with straight tree rows, is more easily cultivated, sprayed and harvested than irregular rows on terraced land, but a regular geometric system cannot always be followed. Flat or gently rolling land will not wash when ploughed in straight rows. On the contrary, hillside orchards laid off on a rectangle would necessitate ploughing straight up and down hill in some places, thus forming ready made water furrows and facilitating soil washing rather than hindering it.

There are several recognized systems of orchard planting. For present purposes, it will serve to mention three: the square system, the hexagonal and the water-level. In the first the rows are laid off from thirty to forty feet each way and, in the case of some varieties, much closer, and a tree placed at each corner. In this way the rows and the trees in the rows are equally distanced. The triangle is the base of the hexagonal system It permits of more trees per acre than the square system allows at the same distance between trees and rows. Another advantage of it is that a tree is placed in successive rows at a point midway between two trees in the rows on either side of it. The root systems of trees planted in this manner are thus interspersed, helping to hold soil and preventing erosion.

The system, if it may be called such, generally followed in the hillside plantings of north Georgia, is known as the water level system. In this system each row is curved to follow the contour of the land, that is, it is run off so as to be at right angles to the flow of surface water, thereby presenting maximum resistance to the natural tendency of the top soil to wash off in heavy rains. The rows of trees are planted in this system at more or less regular intervals and the trees in the rows set approximately the same distance apart as the rows. For standard commercial varieties, planting in rows thirty feet apart and thirty feet in the rows this system permits roughly of an average of fifty trees per acre. The cultivation of orchards planted to this system means that each furrow follows the water level and, being at right angles to the natural drainage of excess surface water, constitutes a succession of barriers thereto, the obvious tendency of which is to retard soil washing. On very steep hillsides the land is terraced at intervals, a necessary supplement to water level cultivation in the prevention of soil erosion.

Planting the Tree.

Having laid off the orchard site and staked the points where the trees are to be set, the preparation of the holes and the planting of the trees follow. It has been demonstrated that blasting is the best method of preparing the holes. Beyond making the simple statement that a tree set in a well dynamited hole has every advantage in growth and fecundity in its youth and maturity over trees set in holes dug by hand, nothing more need be said in this bulletin. The initial cost is not materially greater, and if it were twice or thrice the cost of dug holes it still would be the cheaper method. Soil dynamiting should be done early in the fall when the sub-soil is dry and is readily shattered by the force of the explosion. When the sub-soil has been saturated by winter and early spring rains the explosion compacts the wet clay and may, in extreme instances, actually do more harm than good.

Regardless of the method of preparing the holes, they should be filled in with top soil mixed with rotted manure and the trees set deeply therein. If manure is not procurable the tree should be fertilized with cotton seed meal, bone meal, sulphate of ammonia, or nitrate of soda just as growth starts in the spring. Bone meal seems to be the preferred fertilizer for newly planted trees among Georgia apple growers.

Fertilizing Constituents.

The three principal chemical elements of apple trees are:

(1) Nitrogen, which makes for healthy and vigorous leaf and wood growth,

(2) Potash, which constitutes nearly half the ash of trees and is the chief agent in ripening the wood, and

(3) Phosphorus, which plays an active part in ripening the fruit. The needs of individual trees will determine the relative amount of each of these elements to use. Excessive nitrogen in the soil produces a rapid wood growth and dense foliage. A very rapid wood growth is pithy, spongy and comparatively non-productive of fruit buds, while very dense foliage prevents the fruit from coloring well and is favorable to some of the diseases which attack it.

Commercial Fertilizers.

The use of commercial fertilizers in apple orchards is of unquestioned benefit and profit, but their continued use under a system of clean cultivation and without the addition of humus in the form of cover crops, manure, etc., constitutes abuse and should not be practiced. It is well enough to apply them when immediate results are sought, but for permanent results and soil building, the growth of the leguminous crops, such as cowpeas, beans, vetch and clover for nitrogen, rape for the liberation of potash in the soil, rye and oats for humus, is more desirable. Well rotted manure is a splendid fertilizer for young orchards, as is also high-grade bone meal. Bone meal mixed in equal proportions with cotton seed meal is likewise a good combination for non-bearing trees. The addition of cotton seed meal to bone meal gives a somewhat lower percentage of available phosphorus, but has the advantage of being considerably cheaper than straight bone meal. A mixture of these two materials in equal parts makes an excellent fertilizer for newly set trees. The addition of potash to the fertilizer makes a better mixture for bearing trees, but this element is not so essential to the welfare of trees in their first few years of growth. Commercial fertilizers should have the three elements. nitrogen, potash and phosphorus in proportion to the needs of the trees. Ground limestone is beneficial to apple trees of all ages and is especially valuable in growing cover crops which are to be turned under the soil to make humus. Limestone also makes for sound, well matured wood growth and rich foliage.

Fertilizer formulas are subject to alterations in the amount of one or more elements according to the soil deficiencies in the chemical constituents they are designed to supply. It is not practicable, because of the great variation of individual cases, to fix upon a formula that will be universally and uniformly successful. The use of complete fertilizers has been almost entirely supplanted in this State in recent years by high grade bone meal, cotton seed meal, sulphate of ammonia, and nitrate of soda applied separately or mixed to meet the needs of varying degrees of soil depletion or impoverishment.

Cover Crops.

Under this heading come those orchard crops which are sown in the fall and make a winter growth. They are especially beneficial to bearing orchards and young orchards planted in thin or worn soil. The advantages derived from them are several and vital. The most important are as follows: the prevention of soil washing; the addition of organic matter thereto; improvement of the physical texture of the soil; liberation of potash; the direct fixing of nitrogen from the air, as by the legumes, etc.

Cover crops are of two classes, leguminous and non-leguminous, or, in other words, those which gather and fix nitrogen directly from the air in the form of nodules on the roots, and those which do not. Of the first class, clover and vetch are notable examples; oats and winter rye are the second.

Selection of Cover Crops.

The needs of the soil and trees determine the kind of cover crops to plant. Thin, weak soils demand a leguminous crop, one that increases their nitrogen content by the decay of nitrogen nodules and of the plant fibre itself when ploughed under. On the other hand, strong lands not deficient in nitrogen will be held and benefited by winter rye. Cover crops of both classes should be ploughed under in the early spring and not allowed to ripen.

It must be said that the culture of cover crops has not thus far been practiced in Georgia orchards to any extent. The subject seems little understood and very few attempts have been made by the orchardist to work out the kinds and varieties which would be most successful. But the fact that it has not been done does not mean that it cannot be, nor that it is not highly desirable. The culture of cover crops in other apple growing sections of this country is general and is rated as imperatively necessary. It would seem more desirable in Georgia, where apple lands are so heavily eroded by the continued rains of winter and where humus and nitrogen are generally and badly needed. There is no reason to doubt that crimson clover, winter vetch and spring vetch would not grow well in north Georgia orchards if planted at the right season. It is decidedly to the interest of apple growers to turn their attention and interests to the growing of a suitable winter cover crop.

Shade Crops.

A shade crop, to all intents and purposes, is a cover crop except that it grows in the summer season. The only crop of this kind that is grown extensively in this State is cowpeas. Soja beans and velvet beans have been tried out experimentally in a small way and it is probable that their use in the future will be extensive. At the present time, however, cowpeas is the principal shade crop for apple orchards. Besides adding nitrogen and humus to the land, leguminous crops of this character keep down excessive heat in the soil and lessen the bark scalding produced on apple trees by highly reflected light and heat from light colored soil.

Other Orchard Crops.

All grain crops that grow to maturity in young orchards do so at heavy expense to the trees. The most injurious of this class is corn.. It is a heavy surface feeder, using plant food and moisture in great quantities. Also, it quickly overtops young trees, shading them from sunlight and stunting their growth. Cotton, when grown not less than four or five feet from the tree rows, is not hurtful to trees and may be profitably grown. Beans and tomatoes also are not harmful to young trees and the cultivation of these crops will yield a revenue which will go a long way towards defraying the expenses of a non-bearing orchard.

Pruning.

The pruning of apple orchards, while absolutely essential to the development of shapely trees and the production of high class fruit, is, unfortunately, as a rule, sadly neglected, or badly done. Beginning with the planting of the tree it should be assiduously practiced from year to year. Pruning is necessary for formative purposes; to grow larger and finer fruit; to keep the tree within proper limits; to promote ease and efficiency in spraying, cultivating, harvesting, etc.

The subject of pruning is a wide one and cannot be dealt with, except in a rudimentary manner, in this Bulletin. The live grower will make it a study in a personal and specific way, acquainting himself with the habits of growth of varieties and pruning each tree according to its individual requirements.

As an example, he will take a tree from its transfer to the orchard as a one-year old to bearing age. When set in the orchard the top of the young tree is cut off to a height of from 18 to 24 inches. From the shoots which start out from the stub select three or four which are distributed at equal distances about the circumference. These three or four branches should not arise from a common point on the trunk, but should be staggered about it. If this effect is obtained the liability of the main limbs to breakage in after years, at the point where they join the trunk, is greatly reduced. After procuring the requisite number of rightly placed limbs, remove all other growth, allowing only the selected limbs to grow the first year· The idea is to get the frame work of what eventually will be a low, open-headed or modified vase-shaped tree, though this form of pruning will have to be modified in some varieties because of their inherent peculiarities of growth, or wholly abandoned in favor of the pyramid, or central shaft, type. Most varieties lend themselves readily to the formation of a semi-vase type, which is generally regarded superior to other types, all things considered.

At the end of the first season's growth cut back the branches to stubs 12 to 14 inches long. From the branches arising from these stubs the following season remove all those which grow in such a way as to tend to close the vase-shape form. Most of the laterals from these stubs should come from the buds on the outside.

After the second year, pruning should be checked somewhat and heavy heading-in should be avoided, because of the excessive lateral growth produced by bobbing terminal growth. Winter pruning may be done at any time after the trees become dormant, preferably in the early spring before growth is renewed, for the reason that the amputated limbs are less likely to suffer from "die-back."

Many mistakes in formative pruning have been made by Georgia growers, not the least of which is the long shanks, called by some "mule-tails," or naked limbs from trunks to the first lateral growth. This makes a very unsightly, top-heavy tree, very susceptible to sun-scald·

Cultivation.

That the apple is a clean culture crop in its most productive and profitable form would seem to afford no argument. Cultivation of the soil aids in the liberation of plant food, conserves moisture, improves the physical texture, etc· No matter how rich in plant food chemicals the soil may be, its richness is locked up and useless if the soil is hard and baked and lumpy. Tillage fines the soil, increases its depth, holds moisture and adds humus.

Deep ploughing obviously is out of the question after the orchard is established, but it may be practiced in the tree row middles several years after planting. The top soil in some of our extensive apple-growing sections is shallow and the clay sub-soil hard and impenetrable to rain. By breaking up this water resistant clay to a considerable depth it catches and holds rains to better advantage, conserving moisture and yielding it up gradually for long periods in seasons of drouth. The hard pan beneath the thin top soil is comparable to a board bearing a few inches of loose soil. Heavy rains first saturate the top soil and then, not being able to enter the hard surface beneath, the water runs off, sweeping the loose soil with it.

Cultivation of bearing orchards should be light. No orchard should ever be worked when the soil is wet. Disc and spring-tooth harrows give heavier draft than smoothing harrows or drags and are suitable for use in early summer. The lighter type is used mainly to conserve moisture, hence is intended more to break up capillary action in the soil and to produce a dust mulch·

GEORGIA DEALERS IN SPRAY MATERIALS.

Below is given a partial list of Georgia dealers who handle insecticides such as lime sulphur, atomic sulphur, arsenate of leaf, Black Leaf 40, etc. Most insecticides needed in small quantities for the home garden or for fruit trees in the yard, can be purchased from local drug stores.

Atanta, Ga.
- H. G. Hastings Co.
- Letton-DeFoor.
- Jacobs Pharmacy Co.
- Georgian Pharmacal Co.

Augusta, Ga.
- N. L. Willet Seed Co.

Baldwin, Ga.
- W. A. Shore.

Cornelia, Ga.
- F. C. Neel.
- W. R. Finch.
- Cornelia Hardware Co.

Ft. Valley, Ga.
- Green-Miller Co.
- Southern Brokerage Co.
- J. W. Woolfolk.

Thomasville, Ga.
- R. Thomas.

Georgia Dealers in Spray Machinery.

The following is a partial list of Georgia dealers who handle spraying machinery. Knapsack sprayers, bucket pumps and other apparatus for use in gardens and about the home grounds can usually be purchased from local hardware dealers, or can be ordered through them.

Atlanta, Ga.
- Beck & Gregg.
- Crumley-Sharp.
- Dinkins-Davidson.
- The Dunn Machinery Co.
- Fairbanks, Morse & Co.
- The Goulds Mfg. Co.
- Fulton Supply Co.
- King Hardware Co.

Albany, Ga.
- Albany Farm Machinery Co.
- Sparks Hardware Co.

Columbus, Ga.
- Phillips Hardware Co.

Cornelia, Ga.
- W. R. Finch.
- F. C. Neel.

Ft. Valley, Ga.
- Green-Miller Co.
- Southern Brokerage Co.
- Southern Orchard Supply Co.

Macon, Ga.
- Williams Mfg. Co.

Savannah, Ga.
- Heidt-Hazlehurst Hdw. Co.

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Georgia
State Board of Entomology

BULLETIN 55 **MAY 1919**

ANNUAL REPORT
OF THE
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FOR 1918

BY

A. C. LEWIS
State Entomologist

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Plant Pathologist, Thomasville.

B. M. GADDIS,
Superintendent Valdosta Station, Valdosta.

W. H. LEONARD,
Superintendent Thomasville Station, Thomasville.

J. C. MANESS,
Field Agent, Atlanta.

A. J. FLEMING,
Field Agent, Thomasville.

J. H. PRESSLEY,
Field Agent, Valdosta.

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ANNUAL REPORT OF THE STATE ENTMOLOGIST FOR 1918

To the Honorable Members of the Georgia State Board of Entomology and the General Assembly:

I have the honor as State Entomologist to submit herewith a detailed statement of the receipts and expeditures and a report upon the work of the Department of Entomology for 1918.

The personnel of the staff has undergone a number of changes during the year. Mr. E. L. Worsham resigned as State Entomologist in January, his resignation to take effect the first of February. The present incumbent was elected Acting State Entomologist in his place and later State Entomologist.

Mr. W. W. Chase was elected Assistant State Entomologist for the remainder of the year.

There were other minor changes in the office staff as follows: Mr. W. F. Turner, Assistant Entomologist, stationed at Thomasville Station, resigned the first of September. Mr. Turner had been in charge of the dusting experiments at Valdosta for the control of the boll weevil. In order that the work might not be stopped altogether he worked a few days in September. In December he was elected to the position of Assistant Entomologist and entered upon his duties again with the Board December 15th.

Miss Annie Sharp, who has been connected with the Department for a number of years as artist, resigned July 1st, on account of ill health. Miss Sharp's services as artist have been of valuable assistance to the Department and she has done much good work.

Miss Annie Crayton resigned her position as stenographer at the Thomasville Station October 20th, and Miss Inez Williams succeeded her.

A. M. Turner, who was secretary and bookkeeper, resigned December 31st. W. L. Neese was elected to fill his position, and in order to become familiar with the work of the Department, began his duties December 15th.

Mrs. James K. Jordan was connected with the Department from January 1st to May 31st.

Miss Madge Sewell was employed as assistant stenographer from November 18th to January 31st.

The personnel of the staff, with these exceptions, remains unchanged, as follows:

W. V. Reed, Assistant Entomologist,
Ira W. Williams, Cotton Specialist,
C. A. McLendon, Expert in Cotton Breeding,
W. H. Leonard, Superintendent Thomasville Station,
B. M. Gaddis, Superintendent Valdosta Station,
J. C. Maness, Field Agent,
A. J. Fleming, Field Agent,
Mrs. W. A. Maguire, Stenographer.

All the members of the Staff and the office force have rendered very efficient service and have worked together for the best welfare of the Department.

Lieutenant C. G. Crittenden, Plant Pathologist, who was granted an idefinite leave of absence to serve his country in the Army and who was sent over-seas, was killed in action October 2nd, 1918. His death was keenly regretted and a Memorial to his memory is inserted in this Report.

WORK CONDUCTED BY THE GEORGIA STATE BOARD OF ENTOMOLOGY.

The work conducted by the Georgia State Board of Entomology this year may be classified as follows:

1. Nursery and other inspection work.
2. Enforcement of quarantine regulations.
3. Sweet potato weevil.
4. Work on apple and peach insects and diseases.
5. Garden and truck crop insects and diseases.
6. Cotton breeding.
7. Cotton variety tests.
8. Cotton boll weevil tests.
9. Dusting to control the boll weevil.
10. Work at Thomasville and Valdosta Stations.
11. Citrus Canker.
12. Publications.

NURSERY AND OTHER INSPECTION WORK.

During the year 103 nurseries were inspected and certificates granted,—list of these is appended.

The nursery inspection work requires a good deal of time, as the nurseries are scattered all over the State. This work, if thoroughly performed, requires much time and attention in order to determine whether any injurious insects or plant diseases are present in the nurseries. In every case where the San Jose Scale is found the infested trees are destroyed and a re-inspection made before a certificate is granted. On account of the sweet potato weevil being present in one county in Georgia other states have adopted quarantine regulations against Georgia in regard to the sweet potato weevil. Because of these regulations it has become necessary to inspect the premises of all parties desiring to ship sweet potatoes, sweet potato plants, cuttings and tubers from Georgia in to other states. This has necessitated a good deal of work. During the season of 1918-1919 134 premises were examined and sweet potato certificates granted. A list of these is appended.

All foreign shipments of plants into the State are inspected upon arrival for the gypsy moth and other injurious plant diseases. This year only 11 nurseries received foreign shipments—these shipments contained 51,437 plants. No dangerous insects or plant diseases were found on any of the shipments. A list of the firms receiving these shipments, together with the point of origin, is appended. The inspection of this foreign stock is very important so as to prevent the introduction into the State from these foreign countries of any dangerous insects or plant diseases.

A number of apple and peach orchards were inspected at the owners' request and advice given on the control of the insects or diseases found in the orchards. Many private grounds, in the city of Atlanta and other cities, and in different counties, were inspected at the owners' request and methods given for controlling the pest found to be present. Many cotton fields are inspected each summer for the boll weevil, cotton wilt, and other insects and plant diseases.

ENFORCEMENT OF QUARANTINE REGULATIONS.

The quarantine regulations the Board now enforces are:

1. Those in regard to the shipments of nursery stock in the State, and that from other states and foreign countries into Georgia.
2. The regulations in regard to the boll weevil and cotton products from infested sections.
3. The pine blister rust.
4. Citrus Canker.
5. The sweet potato weevil.

The rules and regulations in regard to the sweet potato weevil were made in February, 1918, the sweet potato weevil (Cylas formicarius Oliv.) having previously been found in the Southern part of Charlton County, south of the G. S. & F. Railway. This section of Charlton County was quarantined and shipments of sweet potatoes, sweet potato plants, cuttings, tubers, morning glory vines and roots, from this section to other sections of Georgia, were prohibited except on a special certificate. A quarantine was also placed upon the shipment of sweet potatoes, etc., into the State from any state infested by this weevil. We are pleased to announce that this insect has not spread to any other county in Georgia so far as we are aware, and a very careful inspection has been made of all the surrounding counties.

In co-operation with the Bureau of Entomology, Washington, D. C., and the Plant Crop Pest Commission of Florida efforts are being made to exterminate this weevil if possible.

Every year some new insect or plant disease is discovered somewhere in the State, or in the surrounding states, against which we have to quarantine. Next year it will probably be necessary to promulgate quarantine regulations in regard to chestnut blight which occurs in several states, and also the nematode, or eelworm disease of wheat. This has been found in one county in the State, Jackson, and is also known to be present in several other states.

APPLE AND PEACH INSECTS AND DISEASES.

Spraying and dusting experiments were conducted by W. W. Chase, Assistant State Entomologist, for the control of the principal insects and diseases attacking apples and peaches. The dusting experiments on apple insects and diseases will have to be conducted another year or more before any definite recommendations can be given. The dusting experiments on peaches were conducted at Fort Valley, and, as a whole, were very satisfactory. In some cases, however, the curculic was not very well controlled and further experiments will have to be conducted to determine just what mixture should be used to give the best results. Circular No. 24 "Helpful Hints on Dusting Peaches" by W. W. Chase, issued January, 1918, sets forth our recommendations in regard to the dusting of peaches.

GARDEN AND TRUCK CROP INSECTS AND DISEASES.

The work on garden and truck crop insects and diseases has been conducted by Assistant Entomologist W. V. Reed. The truck crop sections around Savannah, Macon, Atlanta and Augusta were visited and instructions given in regard to the control of different insects and diseases.

MOSAIC DISEASE OF PEPPERS.

Spraying experiments were conducted on the control of this disease by W. V. Reed at Experiment, Ga., on the farm of S. D. Riegel. In these experiments Black Leaf 40 was used to control plant lice and to prevent the spread of the disease. The spraying experiments were appreciably successful, but it proved to be very difficult to spray the plants thoroughly enough in the field to destroy all the plant lice. It is now generally admitted that insects, especially plant lice, spread this disease from plant to plant. It is also supposed that the disease lives over winter on several species of perennial plants, such as polkweed and others susceptible to attack. All such plants in close proximity to fields should be destroyed as a precautionary measure. It is believed that by keeping the plants free from insects in the seed bed the loss from the disease could be largely prevented. Experiments along this line will be conducted next year.

COTTON BREEDING.

The cotton breeding work now being conducted by the Department is along three general lines: 1st. To improve the wilt resistant varieties that have already been developed by the Department; 2nd. Breeding and improving an early strain of Sea Island cotton; 3rd. To improve varieties of cotton specially well adapted to central and north Georgia.

In south Georgia breeding work on the wilt resistant varieties is being conducted by the State Entomologist at DeSoto, Lumpkin and Vienna. At DeSoto 200 individual selections were made and seed was saved from four rows and five increase plots for planting next year. These selections were made from the Lewis 63, Council Toole and DeSoto wilt resistant varieties. At Cairo breeding work on the Dix-Afifi, a long staple upland wilt resistant variety, is being continued, a special effort being made to produce a type of this cotton with a more uniform length of lint.

Ira W. Williams and W. H. Leonard are breeding several of the wilt resistant strains at the Thomasville Station. They are also continuing the breeding work on velvet beans which was begun by C. G. Crittenden several years ago. Some of these hybrids are very promising and it is hoped within a few years to have them for distribution.

In eastern and north Georgia C. A. McLendon is conducting breeding tests in 15 counties with 22 co-operators. In this work 220 individual selections were made and planting seed was saved from 10 rows, 8 mass selections and 12 increase plots, representing ten varieties of cotton.

At Vienna a new hybrid was tested out in a small increase plot. It resisted wilt disease very well and made a good yield. This is a cross between the Modella and Half and Half, and is called Hendley's Choice.

The breeding work on the Sea Island cotton, which is being conducted at Valdosta by Ira W. Williams and B. M. Gaddis, is giving very good results and several early strains have been developed. One of these strains, No. 33, this season was very early, prolific, and made a small stalk, and this strain will be tested again on a larger scale. We hope in a few years to have seed of this strain for distribution.

COTTON VARIETY TESTS.

The following variety tests were conducted by the State Entomologist:

Americus (Sumter County) 19 varieties,
Brunswick (Glynn County) 19 varieties,
Lumpkin (Stewart County) 20 varieties,
Vienna (Dooly County) 15 varieties.

C. A. McLendon conducted variety tests at the following points:

Atlanta (Fulton County) 63 varieties,
Cornelia (Habersham County) 4 varieties,
Culverton (Hancock County) 18 varieties,
Rome (Floyd County) 10 varieties,
Waynesboro (Burke County) 15 varieties.

In addition to the above tests a variety test of 48 varieties was conducted at the Thomasville Station by Ira W. Williams and W. H. Leonard.

A complete report upon these tests, with the exception of the one at Thomasville, is given in our Bulletin No. 52 Cotton Variety Tests 1918.

We are now making a special effort to assist as many farmers as possible in the improvement of their cotton. To encourage them to make individual and mass selections the Department now maintains a small gin at Atlanta and Thomasville with which to gin these individual and mass selections. Our co-operative cotton breeders and growers are assisted in making individual selections, and instructions given in regard to making mass selections. The seed cotton from every individual selection is weighed, ginned, and the seed weighed, and then the percentage of lint determined. The percentage of lint produced by the mass selections is also determined. At the Atlanta office 327 single stalk selections were received from 20 individuals and 15 others sent in mass selections.

At the Thomasville Station one hundred and fifty single stalk selections were ginned which were sent in by fourteen parties, and eight mass selections from three others, were ginned.

COTTON WILT AND COUNTY BOLL WEEVIL TESTS.

For the past ten years the Georgia State Board of Entomology has been distributing their wilt resistant cotton seed to the farmers in Georgia in the counties where cotton wilt has been doing more or less damage. At first only a few hundred bushels of wilt resistant seed were sent out each year, but for the past four or five years from two to four thousand bushels of wilt resistant cotton seed were distributed. The Board decided last year that this method of getting wilt resistant seed distributed over the State was costing too much for the results secured, hence another plan of distributing the seed has been adopted. In brief this method is as follows: The Board has employed three men who are known as Field Agents. They visit the different counties and in each county select one or two men to conduct these tests, to whom, free of cost, five to ten bushels of cotton seed are furnished. In the counties where the cotton wilt is present the seed of one of the wilt resistant strains is furnished. The main wilt resistant strains of which seed has been sent out are the Lewis 63, Council-Toole, and DeSoto.

In the counties where the boll weevil is present, but where the wilt disease does not exist, seed is sent out of a variety which we believe will do well for that country under boll weevil conditions. Further north in Georgia where the boll weevil has not yet appeared seed is furnished of a variety which, according to our judgement, is well adapted to that county, our opinion being based upon our observations, experience, and variety tests conducted in that section of the State. This year we conducted work of this nature in 124 counties. These tests are of great value to each county, as we hope in this way to find out which variety of cotton is best adapted to that section. We furnish the best seed we can procure of the variety selected. This seed is usually grown by some one with whom we have been working for a number of years, and is what is known as pedigreed seed. That is, it came originally from one stalk of cotton which was selected for its good qualities, such as earliness, productiveness, and disease resistance. By furnishing one or two men in a county five to ten bushels of this pedigreed seed the party may grow enough cotton to be able to save pure seed, and in a year or two plant his whole farm in this variety, if he so desires. He can in this way become a source from which the farmers of that community may purchase good seed which has been grown in their country. We are making a special effort to instruct each of these men how to improve cotton by selection and also to impress upon them the value and importance of pure seed. This will enable them not only to keep the variety of cotton up to its present high standard, but to improve it still further by continued selection.

In the boll weevil section special instructions are given in regard to fighting the boll weevil, these men visiting the farms every month during the growing season to see that our instructions are carried out. We hope in this way to prove to the cotton growers in the boll weevil section that cotton may be grown successfully and profitably under boll weevil conditions if the right kind of a fight is made on the boll weevil and pedigreed seed planted of a variety well adapted to that section.

DUSTING EXPERIMENTS FOR CONTROL OF BOLL WEEVIL.

Extensive dusting experiments were conducted this year at Valdosta (on Sea Island cotton) by W. F. Turner for the control of boll weevil. Arsenate of lead, calcium arsenate and Lazal were used at different percentages, together with sulphur and lime. Ten different plots, each consisting of one acre, were dusted from one to five times. The first application of dust was applied June 18th and the last application made September 9th. One plot dusted three times July 2nd, 9th and 16th yielded 307 pounds of seed cotton. Another plot dusted four times August 15th, 23rd, September 2nd and 9th yielded 359 pounds of seed cotton, while the check plot yielded 265 pounds seed cotton. These figures seem to indicate that the late dustings gave better results than the early dustings. The results on the other plots in the experiment were somewhat conflicting and hence we cannot from these experiments, make any conclusions or recommendations in regard to dusting for the control of the boll weevil. We believe, however, that this is a promising line of work which may give valuable results if it can be continued on a large scale for a series of years. Plans have already been made to conduct these experiments next season on a much larger scale and we hope in another year to be able to make some more definite statements relative to the control of the boll weevil by dusting.

STATIONS AT THOMASVILLE AND VALDOSTA.

The work on the Stations at Thomasville and Valdosta under the direction of Ira W. Williams, assisted by W. H. Leonard and B. M. Gaddis, has been of great value to the cotton growers of Georgia. At Thomasville there are being conducted a number of experiments on growing cotton under boll weevil conditions on land infected with cotton wilt and nematode worms. These experiments are briefly as follows: A variety, fertilizer, and distance test; a sytem of rotation for the elimination of the nematode worm from the soil; and experiments on cotton anthracnose and leaf spot, or black arm. At the Valdosta Station, which is devoted entirely to Sea Island cotton, the work has been mainly breeding up an early wilt resistant strain of Sea Island cotton that can be grown profitably under boll weevil conditions. Fertilizer, distance tests, etc., are conducted covering the same points as those on short cotton at Thomasville. The results already secured from the experiments on cotton breeding are very encouraging, an early strain of Sea Island, No. 24, having been secured, which we hope to develop so that it can be grown with profit under boll weevil and wilt conditions. When next year's experiments are completed at Thomasville and Valdosta a bulletin will be published giving in detail the results secured at these Stations.

CITRUS CANKER.

The work on the elimination of citrus canker in co-operation with the Federal Horticultural Board and the U. S. Bureau of Plant Industry has been completed. The Federal Horticultural Board terminated their work in Georgia the first of July, 1918, as they considered the State was now free from citrus canker. During the fall a re-inspection was made of all points in the State where citrus canker had been found during the last eighteen months, in order to determine if there were any re-infections at these points where the diseased trees had been destroyed. This work was done by W. V. Reed, Assistant Entomologist. Altogether 26 points in 21 counties were re-inspected with negative results. A close watch, however, will be kept in the future for any recurrence of this disease at these, or other points in the State where citrus trees are grown. By means of this re-inspection each year and the enforcement of our quarantine regulations on citrus stock we hope to be able to keep this disesae out of the State.

INSECTS AND DISEASES OF THE YEAR.

The common insects that occur every year, such as potato beetle, etc., appeared in their usual numbers and where proper methods were used for their control at the right time no appreciable damage occurred. Through bulletins and circulars issued by the Department the farmers and fruit growers are becoming more familiar with the proper methods of controlling these common insects. The cowpea pod weevil were quite common in many places on cotton, but did no material damage. The corn bill bug was sent in from Brooks and Lowndes Counties where they did considerable damage to early corn. A serious outbreak of grasshoppers occurred on the farm of H. H. Arrington, Rome, Ga., but they were successfully controlled by the poison bran mash now usually recommended for the control of grasshoppers. The tobacco flea beetle (Epitrix parvyea) did considerable damage to tobacco on the plantation of the American-Sumatra Tobacco Co., Amsterdam, Ga. This outbreak occurred so late in the season that no experiments could be conducted for its control. A close watch will be kept for an outbreak of this insect next year and experiments will be conducted for its control.

The Hessian Fly of wheat occurred in Henry and Coweta counties doing considerable damage.

Two new insects were discovered for the first time in Georgia. One of these, ground pearls, a species of Margarodes, was sent in from Chula, Ga., and reported as being quite numerous in the soil. The other, Chyrsanthemum

Midge (Diarthronomyia hypogaea) was found on chrysanthemum plants in the greenhouse of A. C. Oelschig & Son, Savannah. This midge was apparently introduced into Georgia from shipments of chrysanthemum plants from Indiana.

A species of springtails occurred in large numbers at different spots on the soil at Omega in Tift County.

Early and Late Blight caused considerable damage to Irish potatoes in north and south Georgia where the potatoes were not properly spread with the Bordeaux mixture.

Anthracnose of rye (Colletotrichum cereale) occurred in several counties doing considerable damage and reducing the crop of rye. Wheat scab (Fusarium culmorum) occurred in north Georgia in several counties, but did not do much damage. In north Georgia several corn diseases were found and in some places these did considerable damage and reduced the yield very materially. These diseases were mainly a Fusarium ear-rot of corn that was found to be quite common around Ellijay and Blue Ridge, and the Physoderma disease of corn which occurred at different sections in Georgia.

Ginseng Blight (Alternarea panax) occurred on ginseng at a number of points in north Georgia and did considerable damage.

The diseases of peaches and apples do not as a rule cause any serious injury now, as sprays for their control are usually employed by all the fruit growers. The bitter rot of apples was, however, unusually severe and did considerable damage in north Georgia to certain varieties that are rather susceptible to this disease.

PUBLICATIONS ISSUED.

The following publications were issued:

BULLETINS.

No. 49—Pecan Insects and Diseases, W. F. Turner, C. S. Spooner and C. G. Crittenden.

No. 50—Cotton Variety Tests, A. C. Lewis and C. A. McLendon.

No. 51—Annual Report State Entomologist, E. L. Worsham.

CIRCULARS.

No. 24—Helpful Hints on Dusting Peaches, W. W. Chase.

No. 25—Boll Weevil Quarantine Regulations, E. L. Worsham.
No. 26—Maintaining the Purity of Cotton Seed, C. A. McLendon.
No. 27—Quarantine Regulations Regarding Sweet Potato Weevil, A. C. Lewis.
No. 28—Facts of Interest About the Georgia State Board of Entomology, A. C. Lewis.

PRESS BULLETINS.

No. 1—Common Insects and Diseases of Irish Potatoes, A. C. Lewis.
No. 2—Service offered the Farmers and Orchardists by the Georgia State Board of Entomology, A. C. Lewis.

Through the Western Newspaper Union plate matter on the following subjects was furnished to most of the county papers:

Lookout for the Army Worm.
Control of the Cotton Red Spider.
Control of the Hessian Fly.
Services Rendered by the Board and Bulletins Available for Free Distribution.
Present Distribution of the Boll Weevil in Georgia.

In addition to this plate matter short articles on timely subjects were given to different newspapers from time to time as the occasion demanded.

DAMAGE CAUSED BY BOLL WEEVIL.

The progress of the boll weevil in north Georgia has been very slow but gradual since 1916. The map appended shows the northern limit of the boll weevil in Georgia in 1918. The extent of the territory covered by the boll weevil was determined by the State Board of Entomology in cooperation with the Bureau of Entomology. This line runs across the State almost exactly as it did last year.

The damage to cotton by the boll weevil last year was very heavy in a number of counties in the southern part of the State, where they had a large amount of rain in July and August. In some counties the yield of cotton was reduced at least 50% by the boll weevil. It may be said, however, that the farmers are now becoming more familiar with the best methods of growing cotton under boll weevil conditions and that good yields of cotton were made in many counties, under boll weevil conditions, in south Georgia. Many of our test plots yielded a bale of cotton per acre under boll weevil and wilt conditions where our instructions were followed.

The damage to crops in Georgia by insects and diseases each year is larger than it should be. This loss, however, is growing less and less every year as the people are becoming more familiar with the proper methods of fighting and controlling insect pests and plant diseases.

It is safe to say without doubt that through the efforts of the Georgia State Board of Entomology in one way and another the State is saved many times what is appropriated to the Department. An effort is being made by the Georgia State Board of Entomology to carry on experiments and other work that will be of valuable assistance to the farmers, truck and fruit growers of the State. This year our staff was not as complete as it should have been on account of the lack of funds, and so we were somewhat handicapped in conducting the work of the Department. An honest effort was made, however, to conduct the Department in an efficient and economical way so as to serve as many people as possible.

We believe the services rendered by the Georgia State Board of Entomology are being appreciated more and more each year. The Legislature, last summer, upon the showing made to the Executive Committee and Committee on Appropriations granted the Department an increase of $10,000 in the appropriation for next year. With this increase we are planning to enlarge our force and thus be better able to take care of the growing demands made upon the Department.

GEORGIA NURSERIES.
(1918-1919)

Following is a list of the Georgia nurseries inspected for the 1918-1919 season:

Cert. No.	Name	Address
84	Acworth Nursery	Acworth, Ga.
95	Anschutz, Mrs. C. L.	Decatur, Ga.
11	Ashford Park Nurseries	Atlanta, Ga.
53	Bacon, G. M., Pecan Grove Nursery	Dewitt, Ga.
61	Baconton Nursery	Baconton, Ga.
30	Barnesville Nursery Co.	Barnesville, Ga.
19	Barrow County Nursery	Carl, Ga.

Georgia Nurseries.—(Continued)

Cert. No.	Name	Address
45	Belcher, W. L., Cairo, Ga., Postoffice	Cornelia, Ga.
32	Bellevue Fruit Farm	Macon, Ga.
81	Bignault G. Nurseries	Savannah, Ga.
88	Blue Ridge Mountain Nursery	Morganton, Ga.
66	Blue Springs Nursery (Fugitt Bros., Prop.)	Albany, Ga.
6	Born's Pecan Farm & Nursery	McRae, Ga.
40	Bremen Nursery	Bremen, Ga.
62	Brown, C. W.	Baconton, Ga.
89	Bullard Pecan Nursery	Albany, Ga.
78	Bulloch Pecan Nursery	Jimps, Ga.
98	Capitol City Nursery (V. E. Lambert, Prop.)	Atlanta, Ga.
41	Carroll County Nursery	Carrollton, Ga.
42	Carrollton Nursery	Carrollton, Ga.
1-C	Citronnelle Nursery & Orchard Co.	Brunswick, Ga.
23	Concord Nursery	Concord, Ga.
31	Cordele Nursery	Cordele, Ga.
83	Crucedale, Florist	Athens, Ga.
39	Cureton Nurseries	Austell, Ga.
4	Curry, T. J.	McRae, Ga.
10	Dahl Floral Co., C. A.	Atlanta, Ga.
5	Dixie Nursery	McRae, Ga.
13	Dixie Nursery (W. L. Stewart Prop.)	Valdosta, Ga.
72	Dixie Nursery, (W. L. Stewart)	Parrott, Ga.
29	Dixie Wholesale Nursery	Marietta, Ga.
87	Dover, H. I., R. F. D. 2	Ellijay, Ga.
27	Duncan, Jno. M., R. F. D. 1	Carnesville, Ga.
57	Dyer Nursery	Sharpe, Ga.
71	Edwards & Patterson	Milledgeville, Ga.
86	Ellijay Nursery	Ellijay, Ga.
8	Ellis, Jesse T.	Griffin, Ga.
73	Empire Nurseries (Dealer) (G. M. Murphey, Prop.)	Atlanta, Ga.
93	Enota Nurseries	Hiawassee, Ga.
35	Equity Nurseries	Hogansville, Ga.
74	Erwin, C. M., 61 Formwalt St.	Atlanta, Ga.
38	Euharlie Nursery	Rockmart, Ga.
100	Excelsior Nurseries	Rome, Ga.
17	Fairview Nursery	Milledgeville, Ga.
75	Fayetteville Nurseries	Riverdale, Ga.
56	Flint River Pecan Co.	Albany, Ga.
96	Freeman, F. K., 1225 Milledge Ave.	Athens, Ga.
1	Fruitland Nurseries (Marcus Tarnok, Prop.)	Augusta, Ga.
7	Georgia Experiment Station	Experiment, Ga.
24	Georgia Nursery Co.	Concord, Ga.
3	Georgia Nurseries	Augusta, Ga.
37	Georgia Seed Co.	Hogansville, Ga.
20	Gheesling, Mrs. J. H.	Greensboro, Ga.
67	Gillgrove Pecan Nursery	Albany, Ga.
63	Glausier Pecan Co.	Baconton, Ga.

Georgia Nurseries.—(Continued)

Cert. No.	Name	Address
1 Special	Grant, Gough B.	Chalybeate, Ga.
59	Hardaway Nurseries	Putney, Ga.
28	Hartwell Nursery	Hartwell, Ga.
25	Hastings, H. G. Co., (Dealer)	Atlanta, Ga.
92	Hiawassee Nursery	Hiawassee, Ga.
86	Hogansville Nurseries	Hogansville, Ga.
33	Idle Hour Nursery	Macon, Ga.
18	Jackson County Nursery	Winder, Ga.
94	Juniata Rose Garden	Decatur, Ga.
103	Keheley, J. T.	Columbus, Ga.
99	LaFayette Nursery	LaFayette, Ga.
97	Lee Nursery, (Dealer)	Atlanta, Ga.
14	Lott, D. & O.	Waycross, Ga.
55	Magnolia Hill Nursery	Meigs, Ga.
47	Magnolia Nursery	Cairo, Ga.
70	Marshal, M. H.	Dawson, Ga.
64	Miller, J. B. Co	Baconton, Ga.
91	Nimbleweill Nursery	Dahlonega, Ga.
82	Oelschig, A. C. & Son	Savannah, Ga.
76	Panola Nursery	Eatonton, Ga.
50	Parker, T. H.	Moultrie, Ga.
69	Parrott Nurseries	Parrott, Ga.
44	Pecan Grove Farm Nursery	Cairo, Ga.
43	Pike County Nurseries	Concord, Ga.
15	Pierce County Nurseries	Blackshear, Ga.
58	Pinson, J. R.	Baconton, Ga.
54	Ramsey Pecan Grove Nursery	Leesburg, Ga.
80	Richardson, A. W.	Savannah, Ga.
68	Richland Fruit Farms	Richland, Ga.
46	Riverside Nursery	Cairo, Ga.
65	Rood Pecan Groves	Albany, Ga.
12	Roseland Nurseries	S. Atlanta, Ga.
52	Smithwick Orchard Co.	Americus, Ga.
101	Smith, W. R. C.	Decatur, Ga.
34	Southern Nut Tree Nurseries	Thomasville, Ga.
90	Staton, A. M.	Clermont, Ga.
48	Stone, B. W.	Thomasville, Ga.
21	Stone Mountain Botanical Gardens	Stone Mountain, Ga.
79	Strain, R. A.	Darien, Ga.
2	Stubb's Nursery	Augusta, Ga.
49	Thomasville Nurseries	Thomasville, Ga.
60	Tomlinson, G. H.	Putney, Ga.
85	Tuck Bros.	Thomasville, Ga.
51	United Nurseries Co.	Moultrie, Ga.
9	Wachendorff Bros., 480 Simpson St	Atlanta, Ga.
26	Ward & Eppinger, R. F. D. 2	Concord, Ga.
22	West View Floral Co., Gordon St	Atlanta, Ga.
16	Williams, Dr. W. P.	Blackshear, Ga.

SWEET POTATO CERTIFICATES.
(1918-1919)

Following is a list of the premises inspected for the sweet potato weevil, and the names of parties to whom certificates were granted:

S. P. No.	Name	Address
42	Alma Plant Co.	Alma, Ga.
61	Abercrombie, T. D.	Ashburn, Ga.
62	Boles, W. I.	Ashburn, Ga.
63	Branch, D. J.	Ashburn, Ga.
48	Baxley Plant Co.	Baxley, Ga,
71	Burke, Sam	Fender, Ga.
18	Ballard, H. & R.	Pavo, Ga.
15	Brier Hill Plantation	Thomasville, Ga.
17	Brooks Co. Plant and Truck Farm	Barwick, Ga.
89	Blakely Farms	Blakely, Ga.
44	Bruce, W. A. Plant Co.	Valdosta, Ga.
43	Brooks, W. S.	Valdosta, Ga.
51	Brooks, R. J.	Baxley, Ga,
128	Carlisle, J. F.	Douglas, Ga.
110	Co-Operative Plant Co.	Homeland, Ga.
93	Co-Operative Farms	Tifton, Ga.
127	Clegg and Pearson	Tifton, Ga.
103	Crow, J. L.	Amboy, Ga.
30	Conger, R. B.	Tifton, Ga.
14	Clark Plant Co.	Thomasville, Ga.
67	Cauther, J. R.	Fender, Ga.
68	Crisp, J. H.	Fender, Ga.
49	Campbell, W. E.	Baxley, Ga,
26	Coleman Plant and Seed Co.	Tifton, Ga.
28	Dixie Plant Co.	Hawkinsville, Ga.
19	Dorris, J. Q. Co.	Valdosta, Ga.
119	Dismuke, Z. C.	Mystic, Ga.
66	Dowd, O. N.	Ty Ty, Ga.
57	Dixie Plant Co.	Ty Ty, Ga.
60	Dasher, J. A.	Valdosta, Ga.
124	Dean, Mattie B.	Baxley, Ga,
58	Dunwoody, C. A.	Baxley, Ga,
25	Davis, J. T.	Tifton, Ga.
108	Deen, D. H.	Alma, Ga.
112	Dalton, J. O.	Homeland, Ga.
23	Davis, J. M.	Tifton, Ga.
41	Dickerson, B. A.	Alma, Ga.
38	Dodd & Co.	Omega, Ga.
97	Farrer, W. M.	Ambey, Ga.
70	Fordham, J. M.	Fender, Ga.
104	Godwin, E. A.	Lenox, Ga.
130	Gantt, W. N.	Hazlehurst, Ga.
95	Huling, S. R. & Co.	Folkston, Ga.
52	Head, B. J.	Alma, Ga.
33	Hollingsworth, J. B.	Ty Ty, Ga.
87	Hollis, S. E.	Baxley, Ga,
109	Ingram & Co.	Jesup, Ga.

Sweet Potato Certificates.—(Continued)

S. P. No.	Name	Address
101	Jones, G. N.	Ashburn, Ga.
113	Johnson, Henry	Folkston, Ga.
78	Jones, M. B.	Tifton, Ga.
90	Johnson, J. H.	Folkston, Ga.
85	Jefferson Farms, The	Albany, Ga.
80	Jenkins Plant Co.	Sumner, Ga.
69	King, J. T.	Fender, Ga.
114	Kirton, S. R.	Argyle, Ga.
105	Lambert, Mrs. E. A.	Denton, Ga.
39	Lindsey, W. W.	Tifton, Ga.
117	Ledford, C. C.	Ashburn, Ga.
21	Lawrence, Joe	Ashburn, Ga.
65	McMichael & Hancock	Sycamore, Ga.
115	Monk, Mrs. W. W.	Sylvester, Ga.
120	Melton, C. W.	Baxley, Ga,
45	Mansor Plant Co.	Valdosta, Ga.
34	Malcom, N. N.	Ty Ty, Ga.
134	McRae, R. B. & C. R.	Boston, Ga.
40	Myers Seed and Plant Co.	Tifton, Ga.
122	McClellon, J. R.	Alma, Ga.
75	McMillan, John H.	Enigma, Ga.
29	Nicholson, J. F.	Ty Ty, Ga.
121	Newton, C. E.	Valdosta, Ga.
84	Oliver, E. W.	Ty Ty, Ga.
47	O'Steen, Levi	Douglas, Ga.
76	O'Quinn, A. E.	Tifton, Ga.
24	Powell, E. L.	Tifton, Ga.
32	Patrick & Roberts	Omega, Ga.
31	Ponder, William	Tifton, Ga.
96	Piedmont Plant Co.	Albany, Ga.
129	Pitts, A. H. & Clements	Pavo, Ga.
111	Roberts, Arthur	Homeland, Ga.
22	Rountree, Sam H.	Folkston, Ga.
126	Rayburn, C. M. & Co.	Pavo, Ga.
100	Roberts, Geo. T.	Ashburn, Ga.
107	Rainey, B. F., Jr.	Ashburn, Ga.
81	Sumner, R. B.	Sylvester, Ga.
20	Sexton Plant Co.	Valdosta, Ga.
27	Sewell, J. W.	Tifton, Ga.
74	Shannon, T. S.	Staunton, Ga.
98	Strickland, H. Z.	Amboy, Ga.
77	Sumner, James	Tifton, Ga.
118	Swindal, D .L.	Tifton, Ga.
99	Shroer, Fred	Ousley, Ga.
82	Stokes, F. F.	Chula, Ga.
73	Sumner, M. C.	Fender, Ga.
88	Southern Nut Trees Nurseries	Thomasville, Ga.
46	South Georgia Plant Co.	Alma, Ga.
54	Simm, A. V.	Valdosta, Ga.
125	Shipp, W. B.	Cordele, Ga.
50	Sullivan, C. W.	Baxley, Ga,
79	Taylor, J. F.	Tifton, Ga.

Sweet Potato Certificates.—(Continued)

S. P. No.	Name	Address
133	Tonawanda Stock & Plant Farms	Kinder Lou, Ga.
16	Thomasville Plant Co.	Thomasville, Ga.
53	Thompson, W. L.	Alma, Ga.
83	Turk, J. F.	Chula, Ga.
37	Ty Ty Plant Co.	Ty Ty, Ga.
102	White, C. W.	Hazlehurst, Ga.
116	Webb's Stock and Plant Farm	Pavo, Ga.
55	White, D. B.	Baxley, Ga,
86	Whiten, J. H.	Baxley, Ga.
35	Willis, C. W.	Tifton, Ga.
36	Willis, G. M., Jr.	Tifton, Ga.
72	Womack, O. E.	Fender, Ga.
56	Willet, N. L. Seed Co.	Augusta, Ga.
106	Williams, E. J.	Ty Ty, Ga.
91	Waukhtel, C. W.	Homeland, Ga.
92	Williams, E. A.	Sylvester, Ga.
64	Walker, J. B.	Ashburn, Ga.
131	Wilkerson, J. L.	Lenox, Ga.

OUT-OF STATE NURSERIES.
(1918-1919.)

Nurseries outside of Georgia wishing to sell nursery stock in this State are required to file a copy of their original certificate of the inspector of the State where the nursery is located and sign an agreement to fumigate stock prior to shipment.

The following is a list of nurseries outside of the State authorized to sell stock in Georgia in 1918-1919:

American Rose and Plant Co.	Springfield, O.
Alabama Gulf Coast Nursesies	Grand Bay, Ala.
Andorra Nurseries	Philadelphia, Pa.
Audubon Nursery	Wilmington, N. C.
Baines, Miss Ella V.	Springfield, O.
Bass, I. E. & Son Pecan Co.	Lumberton, Miss.
Biloxi Nurseries	Biloxi, Miss.
Birmingham Nurseries	Birmingham, Ala.
Bloomfield Nursery and Seed Co.	Monticello, Fla.
Brown, F. W., Nursery Co.	Rose Hill, N. Y.
Bobbink and Atkins	Rutherford, N. J.
Burbank, Luther	Santa Rose, Cal.
Catawba County Nursery	Newton, N. C.
California Nursery Co.	Niles, Cal.
Cedar Hill Orchard and Nursery Co.	Winchester, Tenn.
Chase Orchard Co.	Chase, Ala.
Chipola Nursery	Wewahitchka, Fla.
Citronnele Nursery and Orchard Co.	Citronnele, Ala.
Childs, John Lewis	Floral Park, N. Y.
Combined Nursery Co.	Smithville, Tenn.
Columbia Nurseries	Lake City, Fla.
Commercial Nursery Co.	Monticello, Fla.

Out-of-State Nurseries.—(Continued)

S. P. No.	Name	Address
	Commercial Nursery Co.	Winchester, Tenn.
	Contintel Plant Co.	Kittrel, N. C.
	Cumberland Nurseries, The	Winchester, Tenn.
	Dad Bill Nursery Co.	Smithville, Tenn.
	Davis Franklin Nurseries, Inc.	Baltimore, Md.
	Dreer, Henry A., Inc.	Philadelphia, Pa.
	Eagle Pecan Co.	Pittsview, Ala.
	Easterly Nursery Co.	Cleveland, Tenn.
	Eastern Nurseries, Inc.	Holliston, Mass.
	Empire Farm and Nursery Co.	Baileyton, Ala.
	Farquhar, R. & J. Co.	Boston, Mass.
	First National Nurseries	Rochester, N. Y.
	Florida Nurseries	Monticello, Fla.
	Forest Nursery Co.	McMinville, Tenn.
	Fraser Nursery Co.	Huntsville, Ala.
	Garden Spot Nursery	Lagrange, N. C.
	Glenn Bros., Inc.	Rochester, N. Y.
	Glenwood Nurseries	Morrisville, Pa.
	Glen Saint Mary Nurseries Co.	Glen Saint Mary, Fla.
	Globe Nurseries, The	Bristol, Tenn.-Va.
	Good and Reese Co., The	Springfield, O.
	Great Western Plant Co., The	Springfield, O.
	Green's Nursery Co., The	Rochester, N. Y.
	Greenville Nursery Co.	Greenville, S. C.
	Griffin Nurseries	Port Arthur, Tex.
	Hale, J. C. Co..	Winchester, Tenn.
	Hardy-Field Nursery and Seed Co.	Winfield, Kan.
	Hall, L. W. Co., Inc.	Rochester, N. Y.
	Harlan Farms Nurseries	Lockhart, Ala.
	Harrison's Nurseries	Berlin, Md.
	Hill, D. Nurseries	Dundee, Ill.
	Howell Nurseries	Knoxvile, Tenn.
	Hubbard, T. S. Co.	Fredonia, N. Y.
	Hoopes Bros. and Thomas Co.	West Chester, Pa.
	Huntsville Wholesale Nurseries	Huntsville, Ala.
	Inter-State Nurseries	Macclany, Fla.
	Jacksons and Perkins Co.	Newark, N. J.
	Kelly Bros. Wholesale Nurseries	Dansville, N. Y.
	Kellogg Co., R. M.	Three Rivers, Mich.
	Keltonsburg Nursery Co.	Smithville, Tenn.
	Marble City Nursery	Knoxville, Tenn.
	Meehan, Thos. B. Co.	Dresher, Pa.
	Meehan, Thos. & Sons	Philadelphia, Pa.
	Monticello Nurseries	Monticello, Fla.
	Montrose Nurseries	Peekskill, N. Y.
	Mount Hope Nursery Co., R. F. D. 1	Smithville, Tenn.
	Mount Olive Nursery	Smithville, Tenn.
	Munson Nurseries, The	Denison, Tex.
	Oak Lawn Nursery	Huntsville, Ala.
	Old Dominion Nurseries	Richmond, Va.
	Onarga Nursery Co.	Onarga, Ill.
	Pierson, F. R.	Tarrytown, N. Y.
	Perry Nursery Co.	Rochester, N. Y.
	Roehrs, Julious Co.	Rutherford, N. J.

Out-of-State Nurseries.—(Continued)

S. P. No.	Name	Address
	Rosemont Nurseries	Painesville, O.
	Scarff's Nurseries	New Castle, O.
	Seamen Nursery, The	Seaman, O.
	Shadow Nursery Co.	Winchester, Tenn.
	Shahan, E. M.	Winchester, Tenn.
	Shenandoah Nurseries	Shenandoah, Iowa.
	Simpson Nursery Co.	Monticello, Fla.
	Sonderegger Nurseries and Seed House	Beatric, Neb.
	Southern Nursery Co.	Winchester, Tenn.
	Stark Bros. Nurseries and Orchard Co.	Louisiana, Mo.
	Star Nursery Co.	Smithville, Tenn.
	Schmidt & Botley Co.	Springfield, O.
	Steckler Seed Co.	New Orleans, La.
	Stokes, E. E.	Campville, Fla.
	Starrs & Harrison Co.. The	Painesville, O.
	Summitt Nurseries	Monticello, Fla.
	Summitt Nurseries	Foley, Ala.
	Syler Wholesale Nursery	Meridianville, Ala.
	Taylor, H. S. & Co.	Rochester, N. Y.
	Tennessee Nursery Co.	Cleveland, Tenn.
	Texas Nursery Co.	Sherman, Tex.
	Turkey Creek Nurseries	Macclanney, Fla.
	The United States Nursery Co.	Roseacres, Miss.
	The United States Nursery Co.	Smithville, Tenn.
	Valdesian Nursery	Bostic, N. C.
	Vallance Nursery	Oakland, Cal.
	Van Lindley Nursery Co., J.	Pomona, N. C.
	Watson & Co., F. W.	Topeka, Kan.
	Westminister Nursery, The	Westminster, Md.
	West Hill Nurseries	Fredonia, N. Y.
	Whaton Springs Nursery Co.	McMinnville, Tenn.
	Winchester Nursery Co.	Winchester, Tenn.
	Willadean Nurseries	Sparta, Ky.
	Woodlawn Nurseries	Rochester, N. Y.

FOREIGN SHIPMENTS INSPECTED DURING THE SEASON 1918-1919.

The following firms received shipments from the different countries as indicated:

Idle Hour Nurseries	Macon	Wisbech, England
P. J. Hjort	Thomasville	Angers, France
Ashford Park Nurseries	Atlanta	Boskoop, Holland
G. H. Miller & Son	Rome	Angers, France
Dahl's Nursery	Atlanta	Boskoop, Holland
Wachendorff Bros.	Atlanta	Boskoop, Holland
A. C. Oelschig & Sons	Savannah	Boskoop, Holland
Chas. Woodruff	Macon	Boskoop, Holland
A. W. Richardson	Savannah	Boskoop, Holland
C. A. Rowland	Athens	Yokohoma, Japan
H. G. Hastings Co.	Atlanta	Paris, France

The amount of imported stock was very small as compared to shipments received in previous years. Lack of shipping facilities was no doubt the controlling factor.

FINANCIAL STATEMENTS.

The accounts of the Department were audited by Alonzo Richardson & Company, January 31st, upon the retirement of E. L. Worsham, as State Entomologist, and the report of receipts and disbursements were as given in the tables appended.

The accounts of the Department for the year 1918 were also audited by Alonzo Richardson & Company, and the receipts and disbursements were found to be as in the tables appended. Proper vouchers and receipts covering the disbursements are on file in the office of the State Entomologist.

The receipts show the appropriation received from the State and the money received from the sale of products at Valdosta and Thomasville. Previous to this year a separate cotton fund was kept at Valdosta and Thomasville. This year these funds were discontinued and the funds on hand transferred to our general fund so it would not be necessary to keep a separate account for these funds.

It will be noticed that the Department was due Ira W. Williams for expenses advanced at Thomasville and Valdosta the sum of $225.14, and that the bank balance at the Fulton National Bank was $128.00, making a net overdraft of $97.14. As the Sea Island cotton at Valdosta could not be sold at a fair price it was deemed wise to hold the cotton and in order to keep the running expenses all paid Ira W. Williams advanced the money for this purpose.

It may be well to state here that at the end of the year all bills had been paid, and that there is no outstanding indebtedness to be carried over to next year, except the overdraft mentioned in the above paragraph.

RECEIPTS AND DISBURSEMENTS.

JANUARY 1918.

UNDER

E. L. WORSHAM.

Jan. 1, 1918, Balance, Atlanta		$ 771.28	
RECEIPTS.			
From State Treasurer		$8,500.00	
TOTAL TO ACCOUNT FOR			$9,271.28
DISBURSED.			
Salaries—Entomologist and Assistant		$ 608.31	
Traveling, Entomologist and Assistant		155.77	
Office Salaries		405.00	
Stationery and Office Supplies		14.65	
Bulletins and Circulars		1,722.57	
Postage, Tel. and Tel.		43.38	
Miscellaneous Office Expense		209.10	
Library		10.00	
Laboratory—Labor		40.00	
Travel Board Members		65.39	
Cotton Breeders—Salaries		458.32	
Cotton Breeders—Travel		165.42	
Cotton Seed		3,321.75	
Sacks		562.22	
Field Supplies		12.00	
Valdosta Station:			
Salaries	$100.00		
Field Supplies and Expenses	19.85		
Travel	18.26—	138.11	
Thomasville Station:			
Salaries	$125.00		
Wages	81.40		
Seeds	16.50		
Freight and Express	18.70		
Office Supplies	2.00		
Postage, Tel. and Tel.	8.52		
Miscellaneous Expenses	8.50		
Laboratory Supplies	3.00—	263.62	
TOTAL DISBURSED			$8,195.61
Jan. 31, 1918, BALANCE			$1,075.67
Fulton National Bank		$1,137.11	
Due to Ira W. Williams for Expenses Advd.		61.44	
NET BALANCE			$1,075.67

RECONCILEMENT OF ACCOUNT—FULTON NATIONAL BANK.

E. L. WORSHAM.

JANUARY 31, 1918.

Jan. 31, 1918,	Balance as per Statement	$ 540.99	
	Add State Warrant Deposited 2/1	4,000.00	
		$4,540.00	
	Checks Outstanding:		
	Nos. 1744 to 1769, inclusive	3,403.88	
Jan. 31, 1918,	Cash Journal Balance Folios 62		$1,137.11

GEORGIA STATE BOARD OF ENTOMOLOGY.

RECEIPTS AND DISBURSEMENTS.

January 1 to December 31, 1918.

Jan. 1, 1918, Balance on Hand, Atlanta		$ 771.28

RECEIPTS.

From State Treasurer	$50,000.00	
From Sale of Products—Valdosta	385.74	
From Sale of Products—Thomasville	1,756.57	
From Cotton Funds—Valdosta	468.32	
From Cotton Funds—Thomasville	44.95—	52,655.58
TOTAL TO ACCOUNT FOR		$53,426.86

DISBURSEMENTS.

SALARIES:			
Entomologist and Assistants	$5,373.82		
Inspectors	4.00		
Office	3,995.00		
Cotton Breeders	6,175.00—	$15,547.82	
TRAVELING:			
Entomologist and Assistants	$3,299.57		
Board Members	419.06		
Inspectors	1.50		
Cotton Breeders	4,337.22—	8,057.35	
Stationery and Office Supplies		661.37	
Freight and Express		200.25	
Bulletins and Circulars		3,194.58	
Postage, Telephones and Telegrams		778.59	
Furniture and Fixtures		507.20	
Maps, Charts and Signs		20.50	
Library		98.10	
Laboratory Supplies		172.57	
Laboratory Labor (Ginning Cotton)		197.33	
Publicity		830.00	
Educational		151.27	
Art and Photo Supplies		30.79	
Miscellaneous Office Expense		1,006.17	
TOTAL TO ACCOUNT FOR—FORWARD			$53,426.86
EXPENSES—FORWARD		$31,453.89	

TOTAL TO ACCOUNT FOR—Brought Forward			$53,426.86
EXPENSES—Brought Forward		$31,453.89	
FIELD EXPENSES:			
Cotton Seed	$6,916.22		
Sacks	820.54		
Field Supplies	1,442.98		
Field Expenses	468.81—	8,648.55	
VALDOSTA STATION:			
Salaries	$1,383.33		
Wages	1,229.80		
Seeds	212.70		
Sacks	2.25		
Freight and Express	49.27		
Office Supplies	176.93		
Field Supplies	1,167.18		
Postage, Telephones and Telegrams	139.48		
Travel	853.59		
Miscellaneous Expense	86.83		
Laboratory Supplies	20.35		
Field Expense	544.89		
Rent	21.00—	5,887.50	
THOMASVILLE STATION:			
Salaries	$1,687.00		
Wages	1,991.05		
Seed	69.50		
Sacks	120.41		
Freight and Express	96.38		
Field Supplies	561.59		
Field Expense	1,078.23		
Office Supplies	67.73		
Potage, Telephones and Telegrams	171.94		
Travel	87.31		
Rent	520.00		
Laboratory Supplies	44.27		
Miscellaneous Expense	38.65—	6,534.06	
TOTAL EXPENSES			$53,524.00
Dec. 31, 1918, BALANCE OVERDRAWN			$ 97.14
Dec. 31, 1918, Balance, Fulton Nat. Bank		$ 128.00	
Less Due to Ira W. Williams for Expenses advanced at Thomasville and Valdosta		225.14	
NET OVERDRAFT AS ABOVE			$ 97.14

RECONCILEMENT OF ACCOUNT WITH THE FULTON NATIONAL BANK, ATLANTA.

DECEMBER 31, 1918.

Balance as per Bank Statement		$ 566.69
Less Checks Outstanding:		
No. 2350	$ 75.00	
No. 2352	90.00	
No. 2353	70.00	
No. 2367	147.00	
No. 2368	4.00	
No. 2369	1.20	
No. 2370	2.77	
No. 2371	27.12	
No. 2372	18.97	
No. 2373	2.13	
	$ 438.69	
Balance Cash Journal—Folio 89		$ 128.00

I hereby certify that the above is a true statement of the receipts and disbursements of the Department for the year 1918 as audited by Alonzo Richardson & Company.

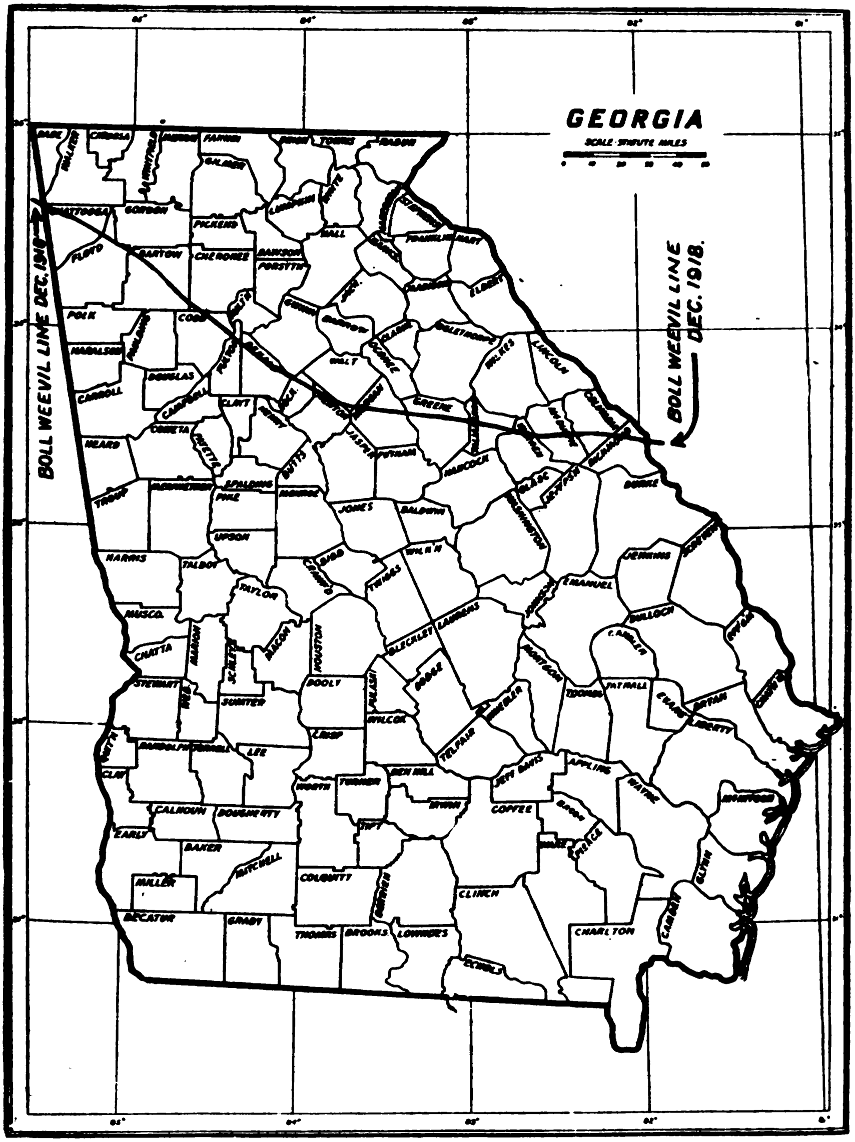
Respectfully submitted,

A. C. LEWIS,
State Entomologist.

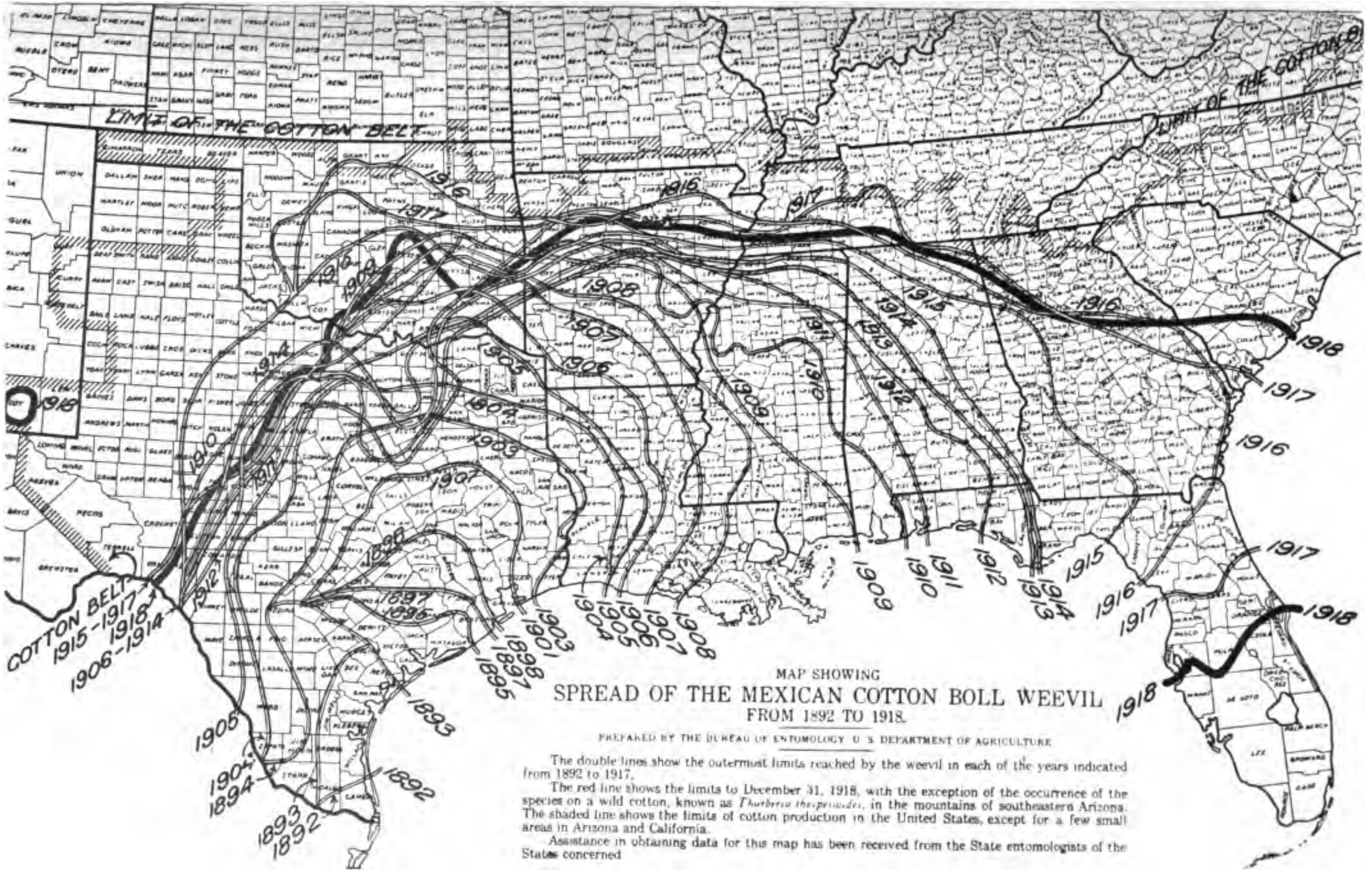
Subscribed and sworn to before me this 21st day of May, 1919.

Mrs. Louise Bigby Marsh Jordan,
Notary Public State of Georgia at Large.

SEAL.



The above line across the map shows the northern limit reached by the boll weevil in Georgia in 1918.



MAP SHOWING
SPREAD OF THE MEXICAN COTTON BOLL WEEVIL
FROM 1892 TO 1918.

PREPARED BY THE BUREAU OF ENTOMOLOGY U. S. DEPARTMENT OF AGRICULTURE

The double lines show the outermost limits reached by the weevil in each of the years indicated from 1892 to 1917.

The red line shows the limits to December 31, 1918, with the exception of the occurrence of the species on a wild cotton, known as *Thurberia thespesioides*, in the mountains of southeastern Arizona. The shaded line shows the limits of cotton production in the United States, except for a few small areas in Arizona and California.

Assistance in obtaining data for this map has been received from the State entomologists of the States concerned

PUBLICATIONS AVAILABLE FOR DISTRIBUTION.

The following publications of the Georgia State Board of Entomology are available for free distribution and may be obtained by writing to the State Entomologist, Atlanta, Ga.

BULLETINS.

No. 26. Peach Leaf Curl, Yellows, Rosette and Little Peach.
No. 34. Wilt Disease of Cotton in Georgia and Its Control.
No. 37. Crop Pest Law of Georgia, Other States and Canada.
No. 40. Cotton Wilt in Georgia.
No. 42. Annual Report of State Entomologist for 1914.
No. 43. The Principal Parasites of the Peach.
No. 44. The Mexican Cotton Boll Weevil.
No. 45. Annual Report of State Entomologist for 1915.
No. 46 Cotton Variety Tests for 1916.
No. 47. How to Grow Cotton in Spite of the Boll Weevil.
No. 48. Annual Report of the State Entomologist for 1916.
No. 49. Pecan Insects and Diseases.
No. 50. Cotton Variety Tests for 1917.
No. 51. Annual Report of State Entomologist for 1917.
No. 52. Cotton Variety Tests for 1918.
No. 53. Spray Calendar.
No. 54. Apple Insects and Diseases.
No. 55. Annual Report of State Entomologist for 1918.

CIRCULARS.

No. 6. The Use of Soluble Oils Against San Jose Scale
No. 7. The Hessian Fly in Georgia.
No. 8. Experiments for Control of San Jose Scale, 1907-08.
No. 9. The Brown-Tail Moth.
No. 20. Directions for Making First Year Cotton Selections.
No. 22. Control of Insects Attacking Stored Products
No. 24. Helpful Hints on Dusting Peaches.
No. 25. Boll Weevil Quarantine Regulations.
No. 26. Maintaining the Purity of Cotton Seed.
No. 27. Regulations for Shipment of Sweet Potatoes.
No. 28. Facts of Interest About the State Board of Entomology.

PRESS BULLETINS.

No. 1. Common Insects and Diseases of Irish Potatoes.
No. 2. Service Offered Fruit Growers, Etc., by Board of Entomology.
No. 3. Watermelon Stem-end Rot, its Cause and Prevention.

Memorial

Lieut. Charles Glenn Crittenden

It is with deepest sorrow and regret that the news of the death of Lieutenant Charles Glenn Crittenden was received by the members of the Georgia State Board of Entomology. This excellent young man is another one of those who gave his life to his country in time of need.

Lieutenant Crittenden was born at Oswayon, Pa., on October 15th, 1890; entered Mansfield Normal School, Mansfield, Pa., in 1904, graduated in 1909; entered Cornell University in 1909, graduated in 1913, B. C. Degree.

For a number of years Lieutenant Crittenden was connected with this Department as Plant Pathologist, and in this capacity rendered efficient and faithful service in the discharge of all the duties of his office.

At the entrance of the United States into the World's War, he volunteered his services to his country, receiving an indefinite leave of absence from the Georgia State Board of Entomology. He entered the First Officers' Training Camp at Fort McPherson, Ga., on May 15th, 1917, graduating from there with distinction and was commissioned Second Lieutenant on August 15t5h, 1917, being assigned to the First Division, Battery E, Seventh Field Artillery, and in a short time went over-seas with his Division.

On October 2nd, 1918, while gallantly defending the cause of liberty with his Battery, at Argonne Forest, a mile and a half North of Very, he was severely wounded and died at midnight of the same day, and was buried at Cheppy, (Meuse) France.

Lieutenant Crittenden was a young man of high ideals and quickly earned the confidence and esteem of all those privileged to associate with him. In his death the Georgia State Board of Entomology has lost one of its most efficient workers, and henceforth his name will be lovingly held in our memories as one who freely placed his all upon the altar of liberty, and we wish to here express our deep sympathy to his family.

We, the Georgia State Board of Entomology, deely feeling our loss in the death of Lieutenant Crittenden, wish to express some recognition of our esteem of his high ideals, efficiency, and faithfulness to this Board.

THEREFORE BE IT RESOLVED, That a copy of these Resolutions be transcribed on the minutes of this Board to his memory.

BE IT FURTHER RESOLVED, That a copy of same be sent to his bereaved family.

Read and adopted by the Georgia State Board of Entomology and Staff.

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